Fire Safety Certificate Application

Project	Dublin City Council Fruit Market St Michan's Street, Smithfield, Dublin 7
Report Title	Compliance Report
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Building Regulations 2006 – Part B

Fire Safety Certificate Application

Compliance Report

Project: Dublin City Council Fruit Market
St Michan's Street,
Smithfield, Dublin 7

Client: Dublin City Council

Report No. GG/1213/R1
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Contents

INTRODUCTION

EXECUTIVE SUMMARY

B1 MEANS OF ESCAPE IN CASE OF FIRE

B2 INTERNAL FIRE SPREAD (LININGS)

B3 INTERNAL FIRE SPREAD (STRUCTURE)

B4 EXTERNAL FIRE SPREAD

B5 ACCESS AND FACILITIES FOR THE FIRE SERVICE

B6 MANAGING FIRE SAFETY

APPENDIX 1 INFORMATION, LIMITATIONS & ASSUMPTIONS

APPENDIX 2 DEFINITIONS AND MEASUREMENT

APPENDIX 3 PROVISION OF COMPARTMENTATION - DETERMINISTIC & COMPARATIVE ANALYSIS

APPENDIX 4 CALCULATION OF FEE

OFFICES & CONTACT INFORMATION

INTRODUCTION

DESCRIPTION OF BUILDING

It is proposed to carry out a material change of use and an extension to the existing Fruit Market at St Michan's Street, Smithfield, Dublin 7. The Fruit Market is an existing building in operation since 1892 and is of significant historical importance to the North inner City of Dublin.

As part of the works the following is proposed: -

Material Alterations/change of use

- The existing wholesale market will be repurposed as a food market to include 14 market spaces complete with circulation areas. The market spaces may be further subdivided to permit individual market stalls within these areas. Around the peripheral of the market, space has been allocated for temporary market stalls/kiosk.
- Ancillary spaces to include offices, washrooms, WC's, storerooms, plant rooms, canteen, restaurant.

Extension

- The east elevation will be extended to provide a catering kitchen, restaurant kitchen and conservatory.
- As part of the works to the south elevation the existing footprint of the washrooms will be extended to provide additional WC's serving the food market.

As per Section 9 (2) of S.I. No. 497 of 1997, no works shall be carried out to a building which would cause a new or greater contravention in the building of any provision of these Regulation. Therefore, as part of the material alterations, it is proposed to carry out the following works to significantly improve the overall standard of fire safety within the existing marketplace whilst maintaining the open plan layout of the market: -

1. The fire detection and alarm system will comply with I.S 3218: 2013+A1:2019 Code of practice for fire detection and alarm systems for buildings – system design, installation, commissioning.
2. Emergency lighting will be provided to IS 3217: 2013 + A1:2017 and I.S. EN 1838: 2013
3. Upgrading of plant rooms to be separated in 60-minute compartment construction from the marketplace.
4. Provision of Ansul suppression over open cooking appliances that form part of the food market stalls.
5. Power supply feed to the individual market stalls/kiosk, omitting the requirement for generators and a possible fuel risk.

As the works constitute a material change of use and extension to an existing building it will be subject to a Fire Safety Certificate application.

PURPOSE OF REPORT

The purpose of this report is to demonstrate compliance with the requirements of Part B: Fire Safety, of the Second Schedule to the Building Regulations 2006.

The recommendations of BS 9999 2017 – Code of Practice for Fire Safety in the Design, Management and Use of Buildings, forms the basis for the fire safety design for the Market building and provides a level of fire safety deemed sufficient to satisfy the requirements of Part B of the Second Schedule to the Building Regulations.

The report is subdivided into sections dealing with each of the specific requirements as follows:

B1	Means of Escape in Case of Fire
B2	Internal Fire Spread (Linings)
B3	Internal Fire Spread (Structure)
B4	External Fire Spread
B5	Access and Facilities for the Fire Service

PURPOSE GROUP CLASSIFICATION

Location	Usage	Purpose group classification as per BS 9999: 2017 – Code of practice for Fire Safety Management and use of buildings
Dublin City Council Fruit Market	Food Market	B2

SCHEDULE OF DRAWINGS

The following drawings were used in the preparation of this report: -

Drawing Number	Drawing Title	Scale
GG/1213/01/01	Site Location Map	1:1000 @ A1
GG/1213/01/02	Site Layout Plan	1:400 @ A1
GG/1213/01/03	Existing Ground Floor Plan	1:200 @ A1
GG/1213/01/04 - Rev A	Proposed Ground Floor Plan	1:200 @ A1
GG/1213/01/05	Roof Plan	1:200 @ A1
GG/1213/01/06	Elevations	1:150 @ A1
GG/1213/01/07	Sections	1:100 @ A1
GG/1213/01/08	Occupancy Areas	1:200 @ A1
GG/1213/01/09	Fee Area	1:200 @ A1

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EXECUTIVE SUMMARY

MEANS OF ESCAPE

Sufficient exits are provided from the building to satisfy exit capacity and travel distance requirements.

In the event of an emergency the entire building will be evacuated simultaneously.

CONSTRUCTION

New elements of structure will achieve 60 minutes fire resistance for load bearing capacity.

In accordance with Table 22 of BS 9999 2017 compartment walls are required to be constructed in 30 minutes fire resistance construction. However, as an additional provision, walls enclosing places of special fire risk will be constructed as 60 minute fire resisting compartment walls.

In the case that the new extensions are constructed as a portal frame, in accordance with BS 9999:2017, where the extension has an external wall near the relevant boundary that is required to be fire rated, the supporting portal frame will also be fire protected. Additionally, if the stability of an external wall is linked to that of the portals, the column and rafter members will have fire resistance to avoid premature failure of the relevant external wall.

As stated in Table 28 of BS 9999 (2017) the entire market including ancillary buildings will form a single compartment and will be within the limitations of code guidance for Risk Profile B2 (i.e. single storey building no limit).

ELEVATIONS

The south and east elevations of the building are sufficient distances from the relevant boundaries so that these elevations can be 100% unprotected.

As detailed in Section B4.4 of this report, the extent of unprotected area to the north and west elevations will be within the limits permitted by code guidance.

Existing Walls that are <1m from the relevant boundary, will remain unchanged as part of the works and should achieve a minimum of 30 minutes fire resistance from both sides.

FIRE FIGHTING FACILITIES

There are currently 8 no. existing hydrants located around the perimeter of the existing market building that may be utilised in the event of fire.

Sufficient perimeter access is available from St Michan's Street.

Each access point into the building will be within 18m of a fire appliance parking position and access doors will be provided such that there is no more than 60m between each door and/or the end of that elevation.

Although not required to comply with the requirements of BS 9999 2017, existing permanently open vents are provided at roof level along the ridge of the roof lantern bays. The approximate total vent area calculated over the 8 no. roof lantern bays is 212m^2.

The provision of permanently open vents will assist the Fire Department in clearing the smoke from the building and in the unlikely event of a Fire in the market area will aid in dissipating the heat to inhibit fire spread throughout the building.

B1 MEANS OF ESCAPE IN CASE OF FIRE

B1.1 BASIS FOR COMPLIANCE AND PURPOSE GROUP

Location	Design Basis
Dublin City Council Fruit Market	BS 9999: 2017 – Code of Practice for fire safety in the design, management and use of buildings

B1.2 RISK PROFILE

BS 9999: 2017 offers guidance for buildings based on a risk profile, which considers occupancy characteristics and the growth rate of a typical fire in the type of building which is proposed.

Occupancy Characteristic
The people occupying the building will be awake and unfamiliar with the building. Therefore a 'B' level occupancy characteristic will apply.

Fire Growth rate.
The fire growth rate has been based on a medium fire growth rate. The determination of the fire growth rate as '**medium**', in accordance with Table 3 of BS9999:2017, is based on the following factors: -

- There will be limited fire load in each food market bay i.e. the storage of food produce.
- Storage of food produce will be low to medium level, based on restricted height in each Kiosk with the provision of mid-level perforated ceilings.
- Open cooking appliances will be provided with localised fire suppression (e.g. Ansul).
- Each kiosk/stand will be provided with their own mains fed power supply without the requirement for each kiosk to bring their own generator for power generation i.e. no risk of fuel been stored within the kiosk/stand.
- Areas of increased fire risk will be enclosed in 60 minute fire rated compartment construction.
- There is considerable space separation between the market allocated spaces, with the provision of circulation routes limiting the risk of fire spreading between each market space. Please refer to Appendix 3 of this report for the CFAST analysis carried out for justification of the same.

As per the recommendations of Table 3 of BS 9999:2017, where the fire load consists of a mix of combustible materials '*evenly distributed low to mid-level'*, a **medium fire growth rate** would be considered applicable. The market building is expected to have a similar fire growth rate i.e. low to mid-level storage of food produce for display purposes.

As per Table 3 of BS 9999:2017, a fast fire growth rate is considered applicable where there are stacked combustibles (on or off racking but excluding high racking), which would be more relevant to a Department Store or Retail sales area, where a higher level of combustible materials may be displayed/stacked to ceiling level i.e. Hardware shops, clothes shops, toy shops, furniture store etc.

As further noted in Table 3 of BS9999:2017 (for Shop sales areas) *"Combustibility, quantity and how goods are displayed should be taken into account and the risk category amended accordingly*".

The provisions set out in Table 3 of BS 9999: 2017 recognise that all shop sales areas are not similar, and the level of risk varies depending on the combustibility of the materials, the amount of goods present and how they are displayed.

Based on the limited fire load associated with the display and sale of food, a **medium fire growth rate** is considered applicable to the market building.

Therefore, a **B2 Risk** Profile category will apply to the building.

B1.3 OCCUPANCY

Location	Area (m^2)	Usage	Occupant Load Factor (m^2/person)[1]	Estimated Occupancy (persons)
Ground Floor (Market Area)				
Food Market 1	206	Market	2	103
Food Market 2	211	Market	2	106
Food Market 3	212	Market	2	106
Food Market 4	209	Market	2	105
Food Market 5	208	Market	2	104
Food Market 6	215	Market	2	108
Food Market 7	212	Market	2	106
Food Market 8	181	Market	2	91
Food Market 9	183	Market	2	92
Food Market 10	189	Market	2	95
Dining Area 11	182	Market	1	182
Food Market 12	168	Market	2	84
Food Market 13	189	Market	2	85
Food Market 14	182	Market	2	91
			Market Total	1458
Market Circulation Route	3250	Circulation area	0.75	4334
			Circulation Total	4334
Ground Floor (Ancillary areas)				
Catering Kitchen	61	Kitchen	6	11
Restaurant Kitchen	28	Kitchen	6	5
Conservatory	56	Restaurant	1	56
Restaurant	65	Restaurant	1	65
DCC Offices	25	Office	6	5
Security Offices	11	Office	10	2
			Ancillary Areas Total	144
			Building Total	5936

Note 1: Occupant Load Factors are taken from BS 9999: 2017.

Note 2: The occupancy of plant rooms, stores, the staff canteen, cleaner room and electrical rooms were not considered in the overall occupancy, as these areas will only be occupied on a transient basis by the maintenance team and occupants otherwise taken into consideration elsewhere.

The occupancy of the temporary stalls/kiosk has not been taken into consideration in the overall occupancy as these areas have been taken into consideration under the circulation route occupancy calculation. i.e. worst-case floor space factor.

B1.4 GENERAL REQUIREMENTS FOR MEANS OF ESCAPE

The means of escape is being designed on the basis of the flow chart in Figure 5 in BS 9999. It is noted that the risk profiles of each purpose group/use are determined as per Section B1.1 of this report and accordingly, subsequent minimum package of fire protection measures associated with same are as follows as determined using Clauses 10 and 15-17 of BS 9999.

Clause 10.4.2 Fire Doors and escape routes

Escape routes will follow the normal circulation within the building as far as is practicable. Escape routes that consist of steps, corridors, etc., are generally expected to be safe for occupants to move to a recognized safe place outdoors. Design door equipment and provision along escape routes such that: -

a) All doors on escape routes can be made readily available for use;
b) All emergency fastenings can be checked to ensure that they release, or can be released, in an emergency;
c) Any doors, gates or shutters that are required to be locked in the open position can be so locked;
d) All escape routes and escape doors (both internally and externally) can be kept free from obstruction;
e) Where practicable, fire doors are in positions where they are not likely to be wedged or propped open. Where this is not practicable, fire doors will be provided with hold-open devices on an automatic release mechanism in accordance with BS 7273-4 (category B);
f) Where hold-open devices are not provided for a fire door, the door has a warning notice on it reminding people to keep it closed.
g) Any fire door that subdivides a corridor is provided with vision panels.
h) Any doors, shutters or fire curtain barriers provided for compartmentations do not impede means of escape.
i) Escape routes and escape route signs are adequately illuminated and where necessary, two power supplies are provided, e.g. mains and battery.
j) Final exit doors open into a place of ultimate safety.
k) Door securing systems using swipe cards, combination locks or any other electrical or mechanical device are released in an emergency and failsafe unlocked.
l) Any evacuation lifts can be kept operative.

Clause 10.4.3 Signs and Signage
Exit signage and safety notice signage will meet the requirements of S.I. 299 2007 safety, Health and welfare at work (General application) Regulations 2007, throughout the building to identify clearly the location and direction of the means of escape. In addition to exit signs on storey exits and final exits all changes of direction within corridors and stairs will be marked with intermediate signs. One or more intermediate signs will also be provided where, direct sight of the escape route or of the sign indicating the escape route is obstructed; or to satisfy maximum recommended viewing distances.

Signs in accordance with I.S. EN ISO 7010: 2020 & LC: 2020 & A1: 2020 will be provided on fire doors (except those held open by electric magnetic devices) to indicate that they should be kept shut.

In addition, signs will be provided to indicate the position of all first aid fire-fighting equipment and fire alarm call points.

Clause 10.4.4 Access to the Building and its Surroundings
See Section B5 of this report and the accompanying drawings.

Clause 10.4.5 First Aid Firefighting
Fire extinguishers will be provided to the requirements of IS EN 3-7 and IS 291:2015 + A1 2022.

Clause 12 Evacuation Strategy

Clause 12.2.1 Simultaneous Evacuation
The entire building will be evacuated simultaneously in the event of a fire.

Clause 12.2.2 Phased Evacuation
Not applicable to the proposed design.

Clause 12.3 Progressive Evacuation
Not applicable to the proposed design.

Clause 13 Internal Subdivision and Spatial/Visual Orientation
Not applicable to the proposed design.

Clause 14.1 Designing Means of Escape
The floorings of all escape routes (including the treads of steps, and surfaces of ramps and landings) will have appropriate slip resistance.

Clause 14.2 Acceptable Means of Escape

One or more of the following means of escape will be adopted: -

- ❑ Door leading directly to the outside air (final exit)
- ❑ Door leading to a protected stairway (storey exit)
- ❑ Protected stairway
- ❑ Ramps conforming to BS 8300, at gradient of no more than 1:12.
- ❑ Fail-safe revolving doors and automatic doors in accordance with BS EN 16005 and BS 7036 – 0, provided that either:
    - They are arranged to fail safely in the open position or be easily openable in an emergency; or
    - Outward opening hinged doors, of an appropriate width and fastened in accordance with 15.6.2, are provided immediately adjacent to such doors or turnstiles.

Clause 14.2 Generally unacceptable Means of Escape

Not applicable to the proposed design.

Clause 15.2 Fire Detection and Alarm Systems

In accordance with Table 7 of BS 9999:2017, there is no requirement to provide an automatic fire detection and alarm system to buildings with an B2 Risk Category. However, it is proposed to provide an automatic fire detection and alarm system throughout the building, which will achieve an L1 standard of coverage.

The fire detection and alarm system will comply with I.S 3218: 2013 + A1: 2019 Code of practice for fire detection and alarm systems for buildings – system design, installation, and servicing.

Clause 15.3 Voice Alarms and Public Address Systems

Not applicable to the proposed design.

Clause 15.4 Artificial and Emergency Escape Lighting

All escape routes (internal and external) will be adequately lit with artificial lighting.

Emergency lighting of three hours duration will be provided to IS 3217: 2013 + A1:2017 and I.S. EN 1838: 2013 to adequately indicate and illuminate all escape routes, and so that all firefighting equipment and call points can be easily seen. The emergency lighting signs will be maintained in all windowless accommodation. The following areas will be provided with emergency escape lighting: -

Location	Use of Building/Part of Building	Parts requiring emergency escape lighting
Dublin City Council Fruit Market	Market Building	All escape routes including external escape routes Windowless accommodation, internal corridors exceeding 30m, open plan areas of more than 60m^{2,} sanitary accommodation with a floor area over 8m^2, electricity and generator rooms, switch/battery rooms for emergency lighting, emergency control room.

Note 1: As defined in Table 8 of BS 9999: 2017

Clause 15.5 Exit Signs

Every doorway or other exit providing access to a means of escape, other than exits in ordinary use (e.g. main entrances), will be distinctively and conspicuously marked by an exit sign in accordance with I.S. EN ISO 7010: 2020 & LC: 2020 & A1: 2020.

Clause 15.6 Doors

Clause 15.6.2 Door Fastenings

Door fastenings will comply with Section 15.6.2 of BS 9999:2017. Doors on escape routes will only be fitted with simple fastening devices and the doors will be easily openable without the use of a key.

Any access-controlled doors will return to the unlocked position under any of the following conditions:

- On operation of the fire alarm
- On loss of power or system error
- On activation of a manual door release unit conforming to BS EN 54-11: 2001+A1 positioned on the side approached by people making their escape. Where the door provides escape in either direction a unit should be installed on both sides of the door.

Exit doors from areas holding more than 60 persons will either be free from fastenings or be fitted with panic bolts complying with I.S. EN 1125 2008.

The existing sliding doors at the entrances/exits from the Market will be held in the open position during the market's hours of trading. In order to provide weather protection, draft lobbies will be constructed inside the existing sliding doors, with each lobby including a new set of swing doors, as highlighted on the ground floor drawing (Ref.GG/1213/01/03 Rev A).

These doors will be activated by push bars in accordance with EN 1125 to open in the direction of escape.

Automatic gate where provided will comply with BS EN 16005 and BS 7036 and will either: -

a) Fail safely to outward opening from any position of opening on the activation of the fire alarm; or
b) Be provided with a monitored fail-safe system for opening if the mains power supply fails.

Clause 15.6.3 Direction of Opening

Doors will open in the direction of travel as indicated on the submitted drawings. However, the doors from some areas will open inwards against the direction of escape. This is acceptable as the occupancy of the areas is less than 60 persons.

It is proposed to maintain Exit 18 as opening inwards and against the direction of escape. This is considered reasonable based on the following: -

- Opening the gate in the direction of escape will encroach on the existing public footpath and would pose a health and safety risk.
- The number of people escaping via this route would be low i.e. from the conservatory restaurant and kitchen areas.
- Evacuees approach to this final exit will be in the open air, having evacuated from the kitchen and restaurant areas. The yard will act as an external mustering point and is considered a place of safety i.e. outside.
- The gate will be provided with a thumb turn for means of escape purposes. Unlike a final exit from within the building itself, as the exit gate is located externally along the escape route, where a large mustering/assembly area is located within the external yard, occupants can wait within this place of safety before exiting orderly through the final exit gate.

Clause 15.6.4 Amount of Opening

Doors will open at least 90° and the opening will not impinge on any corridor or escape route. The swing of the door will be clear of any change of floor level.

Clause 15.6.5 Vision Panels

Vision panels will be provided to all double swing doors and all corridor division doors.

Clause 15.6.6 Final Exits

There are 14 final exits in the building. These are: -

- Exit 1 – 3, Exits 5, 9 & 10 & Exits 12 - 17 Serving the Market Area
- Exit 7 Serving the Conservatory
- Exit 8 Restaurant Kitchen and Catering Kitchen

The exits will be dimensioned to be as wide as the escape routes that they serve.

Final exits will be sited to that they are not affected by smoke/fire from openings to transformer rooms, boiler rooms or other similar risks.

Clause 15.7 Protected Power Circuits
The cables for fire alarm circuits should conform to BS 5839-1:2013.

Clause 15.8 Fire Protection of Lift Installations
Not applicable to the proposed design.

Clause 15.9 Mechanical Ventilation and Air Conditioning Systems
All mechanical ventilation in the development will comply with BS 9999:2017 i.e. mechanical ventilation and air conditioning systems will be designed so that air is directed away from protected escape routes and exits, or so that the system is fully/partially shut down in the event of a fire.

Clause 15.10 Refuse Chutes and Storage
Not applicable to the proposed design all refuse will be stored externally.

B1.5 HORIZONTAL MEANS OF ESCAPE

Clause 16.2 Number of Occupants
The number of occupants is noted in Section B1.3 of this report.

Clause 16.3 Layout and Number of Escape Routes and Exits
The requirements of the various sub-sections of Clause 17.3 of BS 9999:2017 are complied with, as set out below.

Clause 16.3.1 Minimum Number of Escape Routes:
The number of escape routes from all rooms or storeys are not less than that indicated in Table 10 of the BS 9999:2017, as follows:

Location	Number of Occupants	Minimum number of exits required	Number of exits provided
Ground Floor			
Market Area	5792	10(1)	11
Catering Kitchen	11	1(2)	2
Restaurant Kitchen	5	1(2)	2
Conservatory	56	1(2)	2
Restaurant	65	2	2
DCC Offices	5	1(2)	1
Security Offices	2	1(1)	1

Note 1: Number of exits required to satisfy travel distance requirements.

Note 2: In accordance with BS9999:2017 a single escape route is acceptable where maximum occupancy does not exceed 60 persons and travel distances are in accordance with the recommendations of code guidance.

Clause 16.3.2 Alternative Escape Routes
See accompanying drawings.

Clause 16.3.3 Single Escape Routes and Exits
Some rooms throughout the development are provided with a single escape route, however this is acceptable as the occupancy will be 60 persons or fewer and the travel distance limit is not extended.

Clause 16.3.4 Inner Rooms and Access Rooms

There are a number of inner rooms within the building. However, the following conditions of BS 9999:2017 are satisfied: -

- The occupant capacity of each inner room does not exceed 60; and
- The inner rooms are not bedrooms; and
- The inner room is entered directly from the access room; and
- The escape routes do not pass through more than one outer room; and
- Travel distance from any point in the inner room to the exit(s) from the access room does not exceed the allowable one-way travel distance; and
- The access room is not a place of special fire risk is and under the control of the same occupier as the inner room; and
- The access room will be fitted with automatic fire detection that operates an alarm that is immediately audible in the inner room.

However, the means of escape from the cleaner room, secondary sub, washrooms and kitchen store is via a lobby into the main market area (which may be considered escape via an inner-inner room. This is considered reasonable based on the areas occupied on a transient basis with limited fire loading in the lobbies accessing the room. Therefore, the small lobbies are considered an extension of the rooms to which they provide access to.

Clause 16.3.5 Planning of Exits in a Central Core.

See accompanying drawings.

Clause 16.3.6 Access to Storey Exits

It is not necessary to pass through any escape stairway to reach another.

Clause 16.3.7 Separation of Circulation Routes from Stairways

Not applicable to the proposed design.

Clause 16.3.8 Storeys Divided into Different Uses

Not applicable to the proposed design.

Clause 16.3.9 Storeys Divided into Different Occupancies

Not applicable to the proposed design.

Clause 16.3.10 Height of the Escape Route

Escape routes will have 2,000mm minimum clear headroom with no projections below this level except door frames.

Clause 16.3.11 Corridors

Clause 16.3.11.1 Protected Corridor

There are two dead end corridors exceeding 2m from the washrooms, however it is not considered necessary to treat these as a dead-end corridors as there is negligible fire load within the toilet areas.

Clause 16.3.11.21 Enclosure of corridors that are not protected.

Any other corridor which are not protected corridors but are used for means of escape will be carried up to the underside of the structural floor above and all openings in the corridor enclosures will be fitted with doors.

Clause 16.3.11.3 Subdivision of Corridors

Not applicable to the proposed design.

Clause 16.3.12 External Escape Routes over a flat roof
Not applicable to the proposed design.

Clause 16.3.13 Progressive Horizontal Evacuation
Not applicable to the proposed design.

Clause 16.4 Travel Distances
Table 11 of BS 9999:2017 recommends the following maximum limits where additional fire protection measures are not provided: -

- B2 Risk Profile – 20m in a single direction and 50m where two or more escape routes are available.

An increase in travel distances is allowed based on the fire protection measures provided in the building as per Section 18 of BS 9999. The market building will be provided with automatic fire detection which allows for a 15% increase in travel distances (applicable to market and ancillary areas), and the ceiling height is at least 8m (applicable to market only) which allows for an additional 21% increase in travel distances in accordance with Table 14 of BS 9999:2017. Taking account of the variations permitted by BS 9999:2017, travel distances within the building are summarised below.

Location	Recommended Maximum Distances (m)		Actual Maximum Distances (m)	
	Single Direction	In two Directions	Single Direction	In two Directions
Ground Floor (Market Area)				
Market TD 1	24	68	-	33.5
Market TD 2	24	68	-	35.2
Market TD 3	24	68	-	28.4
Ground Floor (Ancillary buildings)				
Catering Kitchen	23	57.5	7.2	14.8
Restaurant	23	57.5	3.4	23.6
Cleaner room	23	57.5	16.3	33.3
Male Washroom	23	57.5	14.5	25.1
Female Washroom	23	57.5	15.9	33.7

Note 1: Travel distances have been assessed on the direct recommended distances of BS 9999.

Note 2: Travel distances have been assessed on the recommended distances in Table F.1. of BS 9999.

Clause 16.5 Cellular Plan Floors
Not applicable for the proposed design.

Clause 16.6 Widths of doors, corridors and escape routes
The required storey exit widths will be in accordance with Table 12 of BS 9999:2017 as follows: -

- Market Building – 4.1mm/person (B2 Risk Profile)

An increase in the number of people who can escape through a door is permitted where additional fire protection measures are implemented as per Section 18 of BS 9999:2017. The market building will be provided with automatic fire detection which allows for a 15% decrease in the minimum exit width per person (applicable to market and ancillary areas), and the ceiling height is at least 8m (applicable to market only) which allows for an additional 21% decrease in the minimum exit width per person with Table 14 of BS 9999. Considering the variations permitted by BS 9999:2017, door exit capacities within the building are summarised below.

Door width capacities with fire protection measures implemented: -

- Market area – 3.3mm/person
- Ancillary areas – 3.5mm/person

The following table details the requirements for exit widths from each level and each unit:

Location	Estimated Occupancy	Proposed exit widths (mm)	Exit Capacity (occupants)
Ground Floor:			
Market Area	5792	2 x 3,400, 2 x 3000, 5 x 2630, 2 x 2,100	7,428[4]
Catering Kitchen	11	2 x 850[1]	142
Restaurant Kitchen	5	2 x 850[1]	142
Conservatory	56	2 x 850[1]	142
Restaurant	65	2 x 850[1]	142
DCC Offices	5	1 x 850	60[3]
Security Offices	2	1 x 850	60[3]

Note 1: Where a door width is less than 1050mm, the number of persons safely accommodated by that exit width was calculated using the following equation:

N = 500/m

Where:
N Is the number of persons of persons safely accommodated by the door width.
M is the minimum door width per person.

Note 2: The largest storey exit has been discounted.

Note 3: Occupancy limited to 60 persons for a single means of escape.

Note 4: Exit capacity based on a worst-case scenario of both Exits 1 & 2 not been available as the exits are in close proximity to each other. Therefore, the exit capacity for the market excludes both Exits 1 & 2.

Based on the above storey exit widths, there is sufficient capacity to cater for the calculated occupancy of the building i.e. 5,936 persons.

The following storey exits are provided: -

- Exits 1 to 3 and Exits 12 to 15 from the market area to the Western Elevation onto St Michan's Street.
- Exits 5 from the market area to the Northern Elevation onto Mary's Lane.
- Exit 7 from the Conservatory to the Eastern elevation via exit 18 to Aran Street.
- Exit 8 from the Restaurant Kitchen and the Catering Kitchen to the Eastern Elevation via exit 18 to Aran Street.
- Exits 9 and 10 from the market area to the Eastern Elevation onto Aran Street.
- Exits 11 from the market area to the Northern Elevation onto Chancery Street Via Exit 16 & 17.
- Exit 16 final exit from the Chancery Street yard market to the south elevation.
- Exit 17 final exit from the Chancery Street yard market to the West elevation.
- Exit 18 final exit from the service yard market to the east elevation.
- Exit 19 serving as a final exit to street from Exit 9 onto Arran Street

Escape from the south elevation of the indoor market (i.e. Exit 11) is via the existing Chancery Street open air market, from where final escape is provided via Exit 16 & 17. The area of the open-air market is calculated at 606m^2. Therefore, based on a floor space factor of 0.75m^2/person the occupancy is calculated to be 808 persons.

The clear width of Exit 11 is 3400mm which has capacity for 1,030 persons. Therefore, the final exits from the open-air market need to cater for 1,838 persons (i.e. 1,030 persons + 808 persons). There is sufficient exit capacity between Exit 16 & 17 to cater for 3,483 persons.

Clause 16.7 Methods of Horizontal Escape for Disabled People

A Disabled refuge will be provided where there is change in level from the Chancery Street open market to street level and from the kitchens and conservatory to the east elevation. These refuges will comply with Annex G of BS 9999:2017 and will have a minimum dimension of 900mm x 1,400mm.

An Emergency Voice Communication (EVC) system will also be provided and will comply with BS 5839-9:2011.

B1.6 VERTICAL ESCAPE PROVISIONS

The market building is constructed over a single storey However, the means of escape from the restaurant/conservatory and kitchens is via a stepped and ramped route. It is considered reasonable not to provide fire separation along these external routes based on the following: -

- Alternative means of escape are provided from these areas.
- Figure 16 provides guidance on where external stairs serve multiple storeys and where a fire at a lower level may obstruct the means of escape from upper floor levels. Therefore, in this scenario the stairs should be separated from the reminder of the building in fire separating construction. As the market building is built over one level a fire obstructing one exit will not affect the means of escape from other areas i.e. alternative escape routes provided from these areas and steps do not serve upper floor levels.

Therefore, based on the above, it is considered reasonable not to fire separate these steps from the areas they serve.

B2 INTERNAL FIRE SPREAD (LININGS)

B2.1 BASIS OF COMPLIANCE

The basis for compliance will be the relevant recommendations of Section 34 of BS 9999: 2017.

B2.2 MATERIAL CLASSIFICATION

New Internal wall and ceiling linings and thermoplastic material to be used in windows, roof lights, and ceilings/lighting diffusers are to comprise materials which meet the appropriate classifications specified in Section 34 of BS 9999:2017. In particular, wall and ceiling linings are to achieve the following minimum classifications: -

Location	Surface spread of flame Classification [1]
Protected escape routes, Places of Special Fire Risk, Circulation spaces	Class 0 (national) or Class B – s3, d2 (European)
All Other rooms including open market floor	Class 1 (national) or Class C – s3, d2 (European)
Small rooms of area not exceeding 30m^2 and toilets	Class 3 (national) or Class D – s3, d2 (European)

Note 1: Performance criteria as specified in Table 33 of BS 9999.

If materials with performance ratings obtained in accordance with test methods not specified in Section 34 of BS 9999 are to be used (e.g., DIN or other European Standard), the equivalence of the rating of these materials in BS 9999 performance terms is to be demonstrated.

B2.3 THERMOPLASTIC MATERIALS

Thermoplastic materials which cannot achieve the above will only be used in the following instances: -

External windows where the material can be classified as a TP (a) rigid product.

Rooflights to rooms and circulation spaces (except protected stairs) where the material on its lower surface has a TP (a) rigid or TP (b) classification. The size and disposition of the rooflights will comply with Table 34 and Figure 39 of BS 9999.

Lighting diffusers on ceilings to rooms where the following are observed: -

- Wall and ceiling surfaces exposed within the space above the suspended ceiling (other than the upper surfaces of the thermoplastic panels) will comply with section B2.1 above; and
- If the diffusers are of classification TP (a) rigid, there are no restrictions on their extent; and
- If the diffusers are of classification TP (b), they will be limited in extent as outlined in Table 34 of BS 9999.

Note 1: A thermoplastic material means any polymeric material which has a softening point below 200oC if tested to BS 2782: Part 1: Method 120A: 1990.

B3 INTERNAL FIRE SPREAD (STRUCTURE)

B3.1 BASIS OF COMPLIANCE

The basis for compliance will be the relevant recommendations of Section 30 of BS 9999.

B3.2 LOAD BEARING ELEMENTS OF STRUCTURE

The period of fire resistance for elements of structure has been assessed based on Tables 24 and 25 of BS 9999.

Risk Profile	Ground or Upper Storey	
	Height (m) of top storey in building or separated part	Period of Fire Resistance (mins)
B2	<18	60

Elements of structure are permitted to be 30 minutes in accordance with Table 23 of BS 9999 2017. However, it is proposed all new elements of structure will achieve 60 minutes fire resistance for load bearing capacity.

The specific provisions of test for fire resistance for new elements of structure, etc.

Part of Building	Minimum provisions when tested to relevant parts of BS 476 (minutes)[1]			Method of Exposure
	Load Bearing Capacity	Integrity	Insulation	
External walls (more than 1m away from relevant boundary	60	60	15	From inside (2)
External walls (less than 1m away from relevant boundary	60	60	30	From each side
Compartment walls (3)	60	60	60	From each side
Cavity barrier	-	30	15	From each side

Note 1: Or relevant European Standard.

Note 2: 30 minutes for any part adjacent to an external escape route.

Note 3: In accordance with Table 22 of BS 9999 2017 compartment walls are required to be constructed in 30-minutes fire resistance construction. However, as an additional provision walls enclosing places of special fire risk will be enclosed in 60-minute compartment construction.

PORTAL FRAME CONSTRUCTION

In the case that the new extensions are constructed as a portal frame, in accordance with BS 9999:2017, where the extension has an external wall near the relevant boundary that is required to be fire rated, the supporting portal frame will also be fire protected. Additionally, if the stability of an external wall is linked to that of the portals, the column and rafter members will have fire resistance to avoid premature failure of the relevant external wall.

B3.3 COMPARTMENTATION

B3.3.1 Compartment Sizes

The market building will form a single compartment, and the size of the compartment will be within the limits recommended by BS 9999:2017 for a Risk Profile B2 (i.e. single storey building no limit) in accordance with Section 31.2 and Table 28 of BS 9999:2017.

Although compliance with the recommendations of BS9999:2017 vis-à-vis the provision of fire compartmentation is achieved, to demonstrate that the proposed compartmentation will provide the level of fire safety required to satisfy the requirements of Part B of the Second Schedule to the Building Regulations, both a deterministic analysis and comparative analysis have been carried out, as detailed in Appendix 3 of this report.

The deterministic and comparative analysis demonstrates the benefits associated with the orientation of the market fire loads, the provision of wide circulation routes between market zones/bays and the existing high roof complete with permanent open vents in ensuring that a fire within a single market zone/bay will not spread beyond the zone of fire origin to adjacent market zones.

The results of the deterministic and comparative analysis demonstrate that both the actual area of the fire load and the maximum fire size within a TGD B compliant retail compartment would be multiples of that within the Food market compartment.

Therefore, if compliance with the guidance in Technical Guidance Document B (TGD B) will, *prima facie*, indicate compliance with Part B of the Second Schedule to the Building, then the deterministic and comparative analysis have demonstrated that the proposed compartmentation will provide a greater level of fire safety than that provided by TGD B guidance, therefore satisfying the requirements of Part B of the Second Schedule to the Building Regulations

Areas of increased fire risk (e.g. plant areas) will form separate fire compartments enclosed in 60 minutes fire resisting construction.

B3.3.2 Provision of Compartment Walls

The walls used to separate places of special fire risk, which are ancillary to the building will be constructed as compartment walls/floors.

B3.3.3 Construction of Compartment Walls

Every compartment wall and floor will: -

- Form a complete barrier to fire between the compartments they serve; and
- Have a period of fire resistance of 60; and
- Be constructed in accordance with the guidance below.

B3.3.4 Junction of Compartment Wall or Floor with other Walls

Where a new compartment wall or floor meets another compartment wall or external wall, the junction will maintain the fire resistance of the compartmentation.

B3.3.5 Compartment Wall to Roof Junctions

New compartment walls will be continued up to meet the underside of the roof and fire stopped where necessary at the wall/roof junction. Any gap between the wall and underside of the roof will be as small as practical (less than 50mm) and filled with suitable fire stopping material over the full width of the wall.

The junction between new compartment walls and the roof will be constructed with a zone of at least 1.5m wide on both sides of the wall having coverings of designation AA, AB and AC on a non-combustible sub-strata or deck. The walls will be carried out to the underside of the roof deck and fire stopped with a resilient non-combustible fire stopping material over the full width of the wall.

B3.3.6 Opens between compartments.

Door openings in compartment walls will be protected by fire doors.

Openings for the passage of pipes or other services will be protected as outlined below.

Protected shafts will: -

- Form a complete barrier to fire between the different compartments which the shaft connects; and
- Have a period of fire resistance of 60 minutes; and
- Meet the requirements above for the construction of compartment walls; and
- Be adequately fire stopped where penetrations occur (see below); and
- Be limited to ducts, pipes, and/or as sanitary accommodation and washrooms; and
- Not contain pipes for oil or gas or ventilation ducts if it also contains a stairway and/or lift; and
- Any other protected shaft containing gas or oil pipes will be adequately ventilated direct to the outside of the building.

Clause 32.5 Mechanical ventilation and air-conditioning systems

Clause 32.5.1 General

Exhaust points will be sited away from final exits, combustible building cladding or roofing materials and openings to the building. Ventilation ducts serving protected stairways will not serve other areas. Smoke detectors will be fitted in extract ductwork in the case of a system which recirculates air.

Clause 32.5.2 Ventilation ducts and flues passing Through Fire-Separating Elements

Where air handling ducts passes through fire-separating elements such as compartment wall or enclosure to protected escape routes, then the integrity of those elements will be maintained, using one or a combination of the following four methods.

- Method 1: thermally actuated dampers
- Method 2: fire resisting enclosures
- Method 3: protection using fire-resisting ductwork.
- Method 4: automatically actuated fire and smoke dampers triggered by smoke detectors.

Clause 32.5.2.3 Protected Escape Routes

- Method 1 will not be used where ductwork passes through or serves an escape route.
- Methods 2 and 3 will only be used where ductwork does not serve the escape route it passes through.
- Method 4 may be used for extract ductwork passing through the enclosure of protected escape route.

Clause 32.5.2.5 Installation and Specification of Fire Dampers

Fire dampers will conform to BS EN 15650:2010. They will have an E classification equal to, or greater than, 60 min.

Fire and smoke dampers will also conform to BS EN 15650: 2010. They will have an ES classification equal to, or greater than, 60 min.

Clause 32.5.2.6 Fire-Stopping of Ducts and Dampers

The junction between the air handling system and the wall or floor will be sealed to maintain the fire resistance of the element in which the system is installed.

Clause 32.5.3 Air Handling Voids

Clause 32.5.3.1 Ceiling Voids

Plenum ceiling voids will be arranged in one of the following ways: -

a) Plenum limited to 400m^2;

b) Plenum compartmented by cavity barriers in accordance with Section 33.2 of BS 9999: 2017;
c) Plenum provided with smoke detection in accordance with BS 5839-1: 2013.

The electrical wiring within the plenum ceiling will be enclosed in metal conduit or metal trunking or be mineral-insulated metal-sheathed cables.

If the void above the ceiling above a false ceiling is used for the supply or extraction of air, a smoke detector will be fitted adjacent to each point where ductwork enters or extract ductwork leaves, the storey/compartment in question. These smoke detectors will: -

a. Trigger the closing of the fire damper provided to complete the fire separation; or
b. Cause the smoke to be diverted to the outside of the building.

Ceiling voids over areas of special risk if used for the supply and extraction of air need not be provided with a smoke detector as the air will not be recirculated.

Clause 32.5.3.2 Floor Voids

Not applicable to the proposed design.

Clause 32.5.4 Segregation of Ventilation Ductwork Serving Areas of Special Fire Risk or Carrying Polluted Air.

Certain areas of the building e.g. plant rooms, will have separate and independent extraction systems, and the extracted air will not be recirculated.

Ventilation ductwork conveying polluted air, or servicing places of special fire hazard, will be independent of any other ventilation ductwork serving other parts of the building.

Clause 32.5.5 Recirculating Distribution Systems

As part of the market stalls/kiosks where extract canopies are provided over kitchen cooking facilities these will be recirculation units i.e. any cooking vapour will be extracted and treated within the unit and recirculated back into the market space.

On activation of the Fire Detection and alarm system the extract fans will shut down.

Clause 32.5.6 Air Transfer Grilles

Air transfer grilles will not be installed in:

a. element of construction enclosing compartments or protected shafts;
b. enclosures to protected stairways, protected lobbies, protected corridors, fire-fighting stairways or firefighting lobbies.

Air transfer grilles fitted in any construction or door that is required to be fire resisting will be intumescent type or fitted with fire dampers. Where these grilles are within the enclosure of protected escape routes, they will incorporate fire and smoke shutters operated by adjacent fire and smoke detectors. Fire and smoke shutters will be in accordance with Method 4 or achieve the same performance standard as an FD30s door as part of the door assembly.

Where it is necessary for air transfer grilles to be fitted with fire dampers, the fire dampers will be in accordance with BS EN 15650: 2010.

Clause 32.5.7 Fire-fighting Control

To ensure the effective use of the mechanical ventilation system, override controls will be provided for fire and rescue service use. The controls for the ventilation system will be located adjacent to the fire detection and

alarm control and indication panel. This is to provide an override facility for either fire safety or normal air handling systems.

The signage will be in accordance with BS ISO 3864-1.

Clause 32.5.8 External Ductwork and Exhaust Outlets

Exhaust points form ductwork systems will be sited:

a) At least 5m horizontally separated and more than 1m above any opening (doors, all windows, skylights and ventilation apertures) or intake or discharge feature in the same or adjacent premises, to prevent extracted smoke being recirculated; and

b) A minimum of 10.5m from any combustible wall, cladding or roofing materials.

Clause 32.5.9 Fire-stopping

Where ductwork, or ductwork enclosures, pass through fire-resisting elements of construction, any gap will be adequately fire stopped for the full thickness of the enclosure, so that the level of fire resistance of the joint is not less than that of the fire resisting element.

Clause 32.5.10 Combustibility of Construction Products or Materials and Components

Clause 32.5.10.1 Internal Linings

Any insulation forming part of the construction or the duct itself or applied as an internal lining to ductwork will have a Class 0 surface (national) or B-s3, d2 (European) and be either:

a) A non-combustible material; or
b) A material of limited combustibility

Clause 32.5.10.2 External Insulation

All external insulation will be in accordance with one of the following as applicable: -

a) External insulation within a fire-resisting ductwork enclosure will have a Class 0 surface (national) or B-s3, d2 (European), unless the space between the ductwork and the fire-resisting enclosure is subdivided at each floor level, and wherever the fire-resisting ductwork enclosure penetrates a compartment boundary, by fire-resisting construction with a fire resistance of not less than that of the ductwork enclosure.

b) External insulation not situated within a fire resisting ductwork enclosure will have a rating for surface spread of flame of not less than that for the surface of the wall or ceiling which the ductwork transverses.

c) External insulation will not be within 500mm of a fire damper unless:

    1) The external insulation is a non-combustible material; or
    2) The external insulation is a material of limited combustibility.

Clause 32.5.11 Flexible Joints and Connections

Flexible joints will: -

a) Not exceed 250mm in length
b) Consist of or be protected by material in accordance with BS 476-20 or BS EN 1366-4

Flexible connections will: -

a) Not exceed 3.7m in length
b) Not pass through fire resisting wall or floors or cavity barriers.

Both flexible joints and connections will be constructed of: -

i. Non-combustible materials; or
ii. Materials classified as A1 in accordance with BS EN 13501-1:2007 + A1; or
iii. Materials which, when tested in accordance with BS 476-6, has a fire propagation index of 1 of not more than 12 and a sub-index i1 of not more than 6, and is situated at least 1m from any fire damper; or
iv. Materials which are classified as B-s3, d2 (or better) in accordance with BS EN 13501-1:2007 + A1 if situated at least 1m from any fire damper.

Clause 32.5.12 Components

Surfaces of air-filters, air attenuators and similar components of ventilation systems exposed to the airflow will be inherently non-flammable or so treated as the make them non-flammable for the duration of their recommended working life.

Clause 32.5.13 Flues

If a flue or duct containing flues or appliance ventilation ducts, passes through a compartment wall or compartment floor or is built into a compartment wall, each wall of the flue or duct will have a fire resistance of at least half that of the wall or floor in accordance with Figure 33 of BS 9999.

Clause 32.5.14 Protection of Pipe Openings

All openings through compartment walls and floors will be kept as small as possible, and the pipes will be fire stopped by filling around the pipe with a proprietary sealing which will have the same fire rating as the said compartment wall or floor. All pipes over 40 mm diameter or 160 mm diameter if non-combustible will be provided with an approved intumescent collar, which will be fitted within the compartment wall or floor.

Clause 32.5.15 Protected service shafts

Openings for the passage of pipes or other services will be protected as outlined below.

B3.4 CONCEALED SPACES

New cavity barriers will be provided in accordance with Section 33.1 and Figure 36 of BS 9999 as follows: -

- To close the edge of cavities including around openings
- At the top of an external cavity wall which does not comply with Figure 36 of BS 9999, and at the junction of any such wall with a separating wall; and
- At the junction between an external cavity wall which does not comply with Figure 36 of BS 9999, and every compartment floor and compartment wall; and
- At the junction between a cavity wall which does not comply with Figure 36 of BS 9999, and every compartment floor and compartment wall, or other wall or door assembly which forms a fire resisting barrier; and
- In a protected escape route, above any fire resisting construction which is not carried full storey height, or (in the case of a top storey) to the underside of the roof covering; and
- Where a corridor (which is not a protected corridor) should be sub-divided to prevent fire or smoke from affecting the routes to two exits simultaneously, above any corridor enclosures which are not carried full storey height, or (in the case of a top storey) to the underside of the roof covering; and
- To sub-divide any cavity (including roof space) so that the distance between cavity barriers does not exceed the dimensions in Table 32 of BS 9999.

B3.5 CONSTRUCTION AND FIXING OF CAVITY BARRIERS

Every new cavity barrier will be constructed to achieve at least 30 minutes fire resistance integrity and 15 minutes insulation. The required fire resistance must be achieved from both sides.

It may be formed by any construction provided for another purpose if it meets the provision for cavity barriers. Cavity barriers in a stud wall or partition or provided around openings may be formed of; -

a) Steel at 0.5mm thick; or
b) Timber at least 38mm thick; or
c) Polythene sleeved mineral wool, or mineral wool slab under compression when installed in the cavity
d) Calcium silicate, cement based or gypsum-based boards at least 12mm thick

The cavity barriers will in general be fitted to rigid construction and mechanically fixed in position. Where this is not possible the junction will be fire stopped.

B3.6 PROTECTION OF OPENINGS AND FIRE STOPPING

All openings through compartment walls and floors will be kept as small as possible, and the pipes will be fire stopped by filling around the pipe with a proprietary sealing which will have the same fire rating as the said compartment wall or floor. All pipes over 40 mm diameter or 160 mm diameter if non-combustible will be provided with an approved intumescent collar, which will be fitted within the compartment wall or floor. Drainage pipes will be installed within protected enclosures as per diagram 22b of the TGD B.

In particular service penetrations of the designated barriers are to be protected in accordance with the relevant recommendations of BS 8313: 1989 (Section 12) and BS 9999-2017.

B3.6.1 Kitchen Ductwork

All kitchen ductwork will be designed in accordance with BS 5588: Part 9. Access hatches will be provided where there are long runs of ductwork and where there is a change in direction. Every section of ductwork will be capable of verification inspection.

Regular maintenance procedures will be ensured, and cleaning will be carried out at all points along the ductwork to the manufacturer's specifications preventing the build-up of grease within the duct.

During cleaning maintenance, it is essential to ensure that the mechanical and any fire integrity of access provision will be maintained. Staff will be trained to ensure that cleaning is carried out to the manufactures' specifications.

Any penetrations through compartment walls will be sealed to ensure that the requirements outlined in Section B3.5 are met and where necessary, fire rated ductwork will be provided in accordance with BS 476: Part 24, 1987.

B3.7 SPECIAL PROVISIONS

B3.7.1 Materials, Structure and Doorsets

Where a fire performance rating for materials / structure / doorsets is referred to, it shall be taken as meaning (except as noted otherwise is this report), that the material / structure / doorset the performance criteria prescribed in the Technical Guidance Document B.

Where a fire resistance rating for elements of structure and other forms of construction is specified in this report shall mean that the item satisfies the performance criteria prescribed in Table A1 of TGD B i.e. loadbearing capacity, integrity and insulation. This can be determined by reference to EN 1364-1: 2015/ EN 1365-1: 2012/ EN 1365-2: 2014 or to the relevant British standard.

Doorsets which are designated as FDx are to achieve 'x' minutes integrity rating to EN 1634: 2014. Where doors are additionally prescribed as having an FDxS rating in this report, the doors shall have fitted smoke seals which limit the leakage past the head and jambs in accordance with EN 1634-3: 2004

B3.7.2 Photovoltaic Panels

The provision of a Photovoltaic System (PVS) shall be designed and installed to current best practice and include measures to minimize the risk of electrocution to firefighters in the event of an incident.

The Fire Department will require that the installation will be designed incorporating the technical guidance contained in: -

- RC62: Recommendations for fire safety with photovoltaic panel installations, as published by the Fire Protection Association/RISC Authority; and
- NFPA 1 (Fire Code) Section 11.12 for PV Systems; and
- MCS/ECA's Guide to installation of PV Systems.

Furthermore, the Fire Department will also require the following: -

- The roof covering or decking under the arrays shall be of non-combustible materials.
- The building shall have adequate and appropriate warning signages for firefighters to inform them of the presence of a PV System in the building.
- Only solar cables suitable for outdoor applications and severe weather conditions and UV radiation are to be used.

B4 EXTERNAL FIRE SPREAD

B4.1 BASIS OF COMPLIANCE

The basis for compliance will be the relevant recommendations of Section 35 of BS 9999 and BRE Report BR 187 (2014) 'Building Separation and Boundary Distances'.

B4.2 EXTERNAL SURFACES

The external walls of the existing market building will remain unchanged as part of the proposed works.

New external wall surfaces (provided as part of the extension) will meet the following limits as recommended by Figure 47 of BS 9999 2017.

Height of Building Extension (m)	Distance from relevant Boundary (m)
4.2	>1m

Where the elevation of the new extension is >1m from the relevant boundary and the height of the building is less than 18m. in compliance with Figure 47 of BS 9999 2017, there is no further provisions to the external surfaces.

As the building does not contain a storey greater than 18m or more above ground level, any insulation product used in the external wall construction is not required to be constructed of limited combustibility.

B4.3 RELEVANT BOUNDARY

The relevant boundary is indicated on the drawings. The distance for each elevation from the boundary is as follows: -

Elevation	Description of boundary	Distance (m)
North	Centre of the road	6.2
South	Centre of the road	22.2
West	Centre of the road	5.5
East (Restaurant Kitchen)	Opposing store and substation (1)	10
East (Conservatory & Market)	Notional boundary between buildings	4.7

Note 1: The relevant boundary has been taken to the opposing store and substation. This is considered reasonable based on the wall of the substation and storeroom, will be constructed in a minimum of 60-minute compartment construction as highlighted on drawings GG/1123/01/02 & GG/1123/01/04.

B4.4 UNPROTECTED AREAS

The amount of unprotected area permitted on the building elevations have been calculated using the Tables method of BR 187.

Elevation	Distance to Relevant Boundary (m)	Appropriate Enclosing Rectangle (m x m)	Unprotected Area (%)[1]	
			Permitted	Actual
North	6.2	6.6 x 50.8 (9 x 60)	20(2)	8(3)
South	22.2	7.2 x 48.9 (9 x 50)	100	-
West	5.5	6.6 x 96.4 (9 x 100)	20(2)	15(4)
East (Restaurant Kitchen)	10	3.1 x 18 (6 x 18)	100	-
East (Conservatory & Market)	4.7	3.1 x 6.8 (6 x 9)	94(5)	-

Note 1: Where a section of an external wall needs to be protected, it will achieve the fire resistance performance criteria outlined in section 3.2 of this report i.e. 60 minutes integrity and stability and 15 minutes insulation. Note: where the wall is adjacent to an external escape route, the insulation criteria increase to 30 minutes.

Note 2: As per the requirements of BR 187 "unprotected areas less than 20% should be rounded up to 20%."

Note 3: The unprotected areas of the north elevation are based on the windows/doors being the only unprotected areas. Therefore, the existing walls shall achieve 30-minutes fire resistance construction i.e., Blockwork/brickwork construction. The permitted unprotected area Is 180m² and the actual unprotected area is 137m² (windows/doors).

Note 4: The unprotected areas of the west elevation are based on the windows/doors being the only unprotected areas. Therefore, the existing walls shall achieve 30-minutes fire resistance construction i.e., Blockwork/brickwork construction. The permitted unprotected area Is 1108m² and the actual unprotected area is 41m² (windows/doors).

Note 5: The permitted unprotected area of the east restaurant & kitchen compartment enclosure is 94% i.e., 50.8m². The actual area of the compartment enclosure is 21m². Therefore, no further protection is required to this compartment enclosure.

Existing Walls that are <1m from the relevant boundary, will remain unchanged as part of the works and should achieve 60 minutes fire resistance from both sides.

B4.5 NEW ROOF COVERINGS

B4.5.1 Minimum Required Designations

Location	Minimum Designation Required [1]	
	European Class	National Class
Dublin City Council Fruit Market	$B_{roof(t4)}$	AA, AB or AC

Note 1: Performance in terms of the resistance of roofs to external fire exposure is determined by reference to either: -

a) (European tests) Commission Decisions 2005/823/EC amending Decision 2001/671/EC or 22nd November 2005 establishing a classification system for the external fire performance of roofs and roof coverings and any subsequent amendments; or
b) DD CEN ITS 1187-2012; or
c) (National tests) BS 476: Part 3:2004

B5 ACCESS AND FACILITIES FOR THE FIRE SERVICE

B5.1 BASIS OF COMPLIANCE

The basis for compliance will be the relevant recommendations of Section 6 of BS 9999 2017.

B5.2 WATER SUPPLIES

In accordance with Section 22.2 of BS 9999, hydrants should be provided within 90m of an entry point to the building. However, it is proposed to provide hydrants based on one hydrant per 1,000m^2 of the ground floor area, which is a more onerous approach.

The ground floor area is approximately 6,706m^2 therefore a minimum of 7 no. hydrants will be required. There are currently 8 no. existing hydrants located around the perimeter of the existing market building that may be utilised.

B5.3 VEHICLE ACCESS

The building is less than 11m in height and has an area between 2,000m^2 and 8,000m^2. Therefore, vehicle access should be provided to at least 15% of the perimeter. Perimeter access is available from St Michan's Street.

Each access point into the building will be within 18m of a fire appliance parking position and access doors will be provided such that there is no more than 60m between each door and/or the end of that elevation.

Fire tender access to elevations is provided such that fire personnel can access the building from a fire tender parking position within 18m.

B5.4 VENTILATION OF HEAT AND SMOKE

Although not required to comply with the requirements of BS 9999 2017, existing permanently open vents are provided at roof level along the ridge of the roof lantern bays. The approximate total vent area calculated over the 8 no. roof lantern bays is 212m^2.

The provision of permanently open vents will assist the Fire Department in clearing the smoke from the building and in the unlikely event of a Fire in the market area will aid in dissipating the heat to inhibit fire spread throughout the building.

B6 MANAGING FIRE SAFETY

B6.1 BASIS FOR COMPLIANCE

The basis for compliance will be the relevant recommendations of BS 9999: 2017 for the management of fire safety and occupied buildings.

B6.2 MANAGEMENT OF THE FIRE SAFETY STRATEGY

In accordance with Table 5 of BS 9999: 2017, a Level 2 (Adequate) Management System shall be provided and maintained.

B6.3 FIRE SAFETY MANAGEMENT

B6.3.1 Fire Safety Manager

A competent member of the management team will be assigned the role of Fire Safety Manager of the proposed Fruit Market building. This person will have the authority, powers to sanction and resources to take responsibility for: -

- Day-to-day safety management
- Carry out/assign essential repairs and maintenance procedures
- Restricting access to the building or to a specific tenancy
- Shutting down normal operations

The Fire Safety Manager will liaise with Fire Safety Officers and with any Fire Marshalls who might be assigned to assist with evacuation.

The Fire Safety Manager will also: -

- Be aware of all fire safety features and their purposes; and
- Be aware of any particular works on the premises (e.g. hot works, unusual construction materials, etc.); and
- Be aware of their responsibilities towards disabled occupants; and
- Be in attendance on the premises whenever the building is occupied; and
- Liaise with (and seek the advice of) the fire authority and/or any other relevant authorities, as necessary; and
- Have the authority to deal with individuals who sabotage/tamper with fire safety systems, ignore smoking policies or who block escape routes; and
- Ensure that all tenants, concessionaries and caretakers are adequately trained on their responsibilities; and
- Ensure that audits of the building are carried out as necessary; and
- Ensure that all necessary communication devices are in place to deal with any fire incident.

B6.3.2 Caretakers

Where a caretaker is assigned to maintain the building, this person will be adequately trained on the fire safety arrangements for the building.

A caretaker may be assigned the role of Fire Safety Manager and should carry out that role in accordance with the guidance detailed above.

B6.4 COMMUNICATIONS

The Fire Safety Manager will maintain all forms of communication in the building, such that all will be adequately operational in the event of a fire.

The communications procedures will include investigating the nature of the situation (i.e. fire situation, false alarm, etc.), in the event of a fire alarm being activated.

Furthermore, the Fire Safety Manager will be responsible for the maintenance of the Emergency Voice Communication system provided in the disabled refuges in escape stairs.

B6.5 FIRE PREVENTION

As part of the primary 'everyday' task of avoiding the outbreak of a fire, the Fire Safety Manager will:

- Monitor the behaviour of the occupants in the building
- Monitor the smoking policies in the building
- Manage the general housekeeping of common areas
- Ensure that all waste products are disposed of appropriately
- Minimise hazards posed by combustible contents, furnishings and surface finishes
- Minimise hazards posed by materials, components and elements of construction
- Review means by which a fire might start and spread, and the potential consequences
- Assess the risks from new equipment, new business processes or changing/new technologies
- Issue and control Work Permits and associated procedures
- Training and education of tenants
- Establishing and maintaining out-of-hours inspections and security procedures
- Supervising and instructing contractors and sub-contractors
- Routine checks, inspections, tests and monitoring of all equipment which may cause fires

B6.5.1 Housekeeping

Reducing Ignition Sources

All potential ignition sources will be identified and controlled by the Fire Safety Manager and the Fire Safety Officers in each tenancy, including: -

- Smoking
- The use of naked flames (e.g. candles)
- Processes involving hot works
- Misused/faulty electrical equipment
- Overheated/worn cables

All equipment will be installed, maintained and used by competent persons, including relevant staff training, as necessary.

Reducing Fuel Load

Management procedures will ensure that combustible materials are removed or adequately stored, including the following actions: -

- Reduce fire loading by minimising the use of bottled fuels (e.g. gas canisters)
- Ensure goods are stored appropriately (i.e. in dedicated storage rooms)
- Ensure that highly flammable/combustible materials are stored safely, in appropriate storage containers if necessary
- Control the amount of waste material which is stored within the building
- Remove all redundant services, particularly in-service voids

Maintenance of Fire Protection Measures

Daily, weekly and monthly maintenance checks will be carried out on all fire protection equipment, in accordance with the manufacturer's specifications. Maintenance inspections should include the following: -

- Escape routes – escape routes (corridors, stairs, etc.) will be kept clear of obstructions at all times, and will not be used for storage purposes; and

- Fire Doors – door locks, panic ironmongery, self-closing devices and automatic release mechanisms will be maintained such that they are easily openable at all times; and
- Fire alarm call points and fire extinguishers will not be obstructed by stored goods, machinery or parked vehicles at any time; and
- All fire safety equipment (i.e. fire alarms, emergency lighting, fire extinguishers, etc.) will be maintained and tested in accordance with the relevant standards by competent persons; and
- All damaged elements of the building fabric will be repaired/replaced as necessary; and
- All AOVs will be in working order and will open automatically in the event of a fire.

B6.5.2 Security

All security arrangements for the building will be arranged to take into consideration the needs of escaping occupants and the needs of members of the fire service who may need to gain access to the building.

B6.5.3 Contractors/Sub-contractors and Hot Work

The activities of all external contractors and/or sub-contractors in the building will be monitored and supervised by the Fire Safety Manager/Fire Safety Officer, particularly where hazardous activities such as hot work (e.g. welding or cutting) or the use of flammable substances might be used.

Hot work will be restricted by the Fire Safety Manager; Hot Work Permits will be required for any hot works which are expected to be carried out on site – only competent personnel will be capable of receiving a Hot Work Permit.

B6.5.4 Maintenance of Plant Equipment

All electrical, gas and other plant equipment will be maintained on a regular basis by competent persons to ensure that all are in adequate working order in accordance with established good practice. Any maintenance procedures of plant equipment will be carried out and (if necessary) certified by a competent person.

B6.5.5 Escape Routes

In order to ensure that escape routes are available for use at all times, the Fire Safety Manager will ensure that: -

- All escape routes, including stairs, corridors, lobbies and refuge spaces, are free from obstructions at all times; and
- Goods, materials and/or furniture will not be stored within escape routes at any time – all obstructions will be removed immediately; and
- Adequate storage areas/facilities are available within the building; and
- All escape routes will be inspected frequently, and corrective measures will be taken as necessary; and
- Fire doors which are intended to be kept closed are not wedged open or obstructed; and
- Hold-open devices on any fire doors will be operable and will not be obstructed; and
- The exterior of the building will be inspected to ensure that all final exits and routes to assembly points are not blocked by materials, vehicles or (in winter) snow; and
- Furniture will not be provided such that it will limit the exit widths; and
- Fire safety signs and notices, fire extinguishers, alarm call points, escape lighting, and fire doors/shutters/curtains will not be blocked at any time (even temporarily) by furniture, stock, banners, posters, etc.; and
- Seating areas will not be provided within escape corridors/lobbies; and
- Any maintenance/redecoration of surface finishes and floor coverings will be in accordance with B2 of this report; and
- The floors on escape routes will be non-slip and even.

B6.5.6 Maintenance of Fire Safety Equipment & Provisions

All fire safety equipment and provisions will be inspected and maintained in accordance with the guidance of relevant standards and the manufacturer's specifications, including the following: -

- Fire detection and alarm system
- Emergency and escape lighting
- Fire doors
- Fire door automatic-release mechanisms (if any)
- Ventilation systems
- Fire extinguishers
- Fire curtains/shutters
- Fire hydrants
- Automatic opening doors (if any)
- Automatic opening vents

A record of all tests and checks, including lists of defects remedied, will be maintained in a fire safety manual for the development.

B6.6 PLANNING THE RESPONSE TO A FIRE

B6.6.1 Fire Routine

The fire routine for the building sets out the actions which will be taken by staff on discovery of a fire in the building, which will include the following: -

- Reaction of all occupants in the event of a fire situation
- Reaction of all fire safety officers and the fire safety manager in the event of a fire
- Persons who may/may not attempt to fight a fire, which equipment may be used, and when a fire should/should not be fought

As part of the fire routine, all staff will be aware of how different provisions throughout the building will respond, e.g. hold-open devices on doors being released, access-controlled doors unlocking, turnstiles releasing, etc.

B6.6.2 People at Risk

Specific arrangements will be made to assist with the evacuation of any occupants who might be at particular risk, including: -

- Mobility-impaired persons
- Blind and partially sighted persons
- Persons who are deaf or hard of hearing
- Persons with mental health problems
- Persons with learning disabilities
- Persons with any unseen health issues (e.g. heard problems)
- The elderly/young
- Pregnant women

The Fire Safety Officer in each tenancy will maintain lists of persons who might be at risk based on the above (or any other risks) and ensure that all are advised on the specific evacuation procedures, including the location of all disabled/wheelchair refuges.

B6.6.3 Evacuation Management

It will be the responsibility of the Fire Safety Manager and all Fire Safety Officers to ensure that all occupants react promptly upon the activation of a fire alarm. All alarms will be treated as fire situations until staff are otherwise informed/advised.

B6.6.4 Test Evacuations

Test evacuations (i.e. fire drills) will be carried out on (at least) an annual basis, which will allow the Fire Safety Manager and Fire Safety Officers to observe and amend any deficiencies in the fire management strategy/policy.

When fire drills are arranged, a minimal number of persons will be warned of the drill prior to the activation of the fire alarm. This will ensure that the majority of occupants will react as though a real fire event has occurred.

B6.6.5 False Alarms

Where false alarms occur, appropriate steps will be taken to minimise the likelihood of reoccurrence by repair, modification or replacement of detectors. These steps will not reduce the sensitivity or coverage of the fire detection and alarm system.

B6.7 EMERGENCY ACTIONS

B6.7.1 Action on Discovery

Upon discovery of a fire, the fire detection and alarm system will be activated by the nearest safe manual call-point, if automatic detection has not already activated the alarm.

All occupants will calmly evacuate away from the fire, and when safe to do so, the relevant Fire Safety Officer will inform the Fire Safety Manager of the location and extent of the fire.

The Fire Safety Officer will delegate an occupant to contact the Fire and Rescue Service, when safe to do so.

B6.7.2 Evacuation Procedures

A series of evacuation procedures will be issued to all tenants, and all occupants of the building will be familiarised with the evacuation sequence, including the following: -

- The location of escape routes
- The use of lifts during a fire – firefighting lifts will be available for firefighting personnel only, and will not be used for escape purposes
- Evacuation procedures for disabled persons, including the locations of all disabled refuge places
- Communications during a fire situation
- The location fire assembly points
- The responsibilities of Fire Safety Officers and the Fire Safety Manager

It will also be ensured as part of the evacuation procedures that personal belonging should not be gathered and that staff should not re-enter the building until a relevant member of the Fire and Rescue Service says that it is safe to do so.

B6.7.3 Fighting the Fire

Upon discovery of a fire, the above evacuation procedures should be followed, i.e. the alarm should be raised, the fire and rescue service should be contacted, and the building should be evacuated.

Attempts may be made to fight the fire with the equipment provided, if: -

- The occupant fighting the fire has been specifically trained for the purpose; and
- It is deemed safe to do so; and
- Such an action is expected to contain/extinguish the fire; and
- It is likely to have an immediate and direct effect in protecting the lives of escaping occupants.

Where any of the above conditions cannot be met, no member of staff will be permitted to fire the fire, and all occupants will evacuate.

Where it is deemed necessary to abandon efforts at fighting the fire, staff should be instructed to withdraw, close doors behind them and evacuate the premises via the nearest safe escape route.

APPENDIX 1 INFORMATION, LIMITATIONS & ASSUMPTIONS

The information's limitations and assumptions using in the preparation of this report are noted below: -

Building Regulations

This report considers Building Regulations which deal with life safety. Property protection and insurance issues are not addressed in this report.

Other Limitations

Complying with the recommendations of this report will not guarantee that a fire will not occur.

Unless otherwise described in this report, the fire strategy assumes that the building design, the mechanical and electrical systems, construction methods and materials specifications will comply with current Building Regulations guidance, and relevant British Standards and Codes of Practice.

The design of mechanical and electrical systems such as fire alarm and sprinklers are a specialist area. Fire Strategy recommendations are given in this report; however, the design and specifications need to be developed at the appropriate stage in consultation with the specialist designers of these systems.

This report has been prepared for the sole benefit, use and information of Dublin City Council and the liability of Jeremy Gardner Associates Ireland Limited, its directors and employees in respect of the information contained in the report will not extend to any third party.

APPENDIX 2 DEFINITIONS AND MEASUREMENT

DEFINITIONS

Access room - Room through which passes the only escape route from an inner room.

Access level - A level used for normal access to a building that either incorporates, or leads directly to, a place of safety.

Dead-end - Area from which escape is possible in one direction only.

Direct distance - The shortest distance from any point within the floor area, measured within the external enclosures of the building, to the nearest storey exit, ignoring walls, partitions and fittings, other than the enclosing walls/partitions to protected stairways (2/3rd permitted travel distance can be used for design purposes).

Emergency lighting - Lighting provided for use when the power supply to the normal lighting fails.

Escape lighting - That part of the emergency lighting which is provided to ensure that the escape route is illuminated at all material times.

Final exit - The termination of an escape route from a building giving direct access to a street, passageway, walkway or open space, and sited to ensure the rapid dispersal of persons from the vicinity of a building so that they are no longer in danger from fire and/or smoke.

Habitable room - A room used for living or sleeping purposes but does not include a kitchen having a floor area less than 6.5m^2, a bathroom or toilet.

Inner room - A room from which escape is possible only by passing through an access room.

Means of escape - Physical means whereby a safe route or routes is or are provided for persons to travel from any point in a building to a place of safety.

Places of special fire risk - Transformer and switchgear rooms, large commercial kitchens, boiler rooms, fuel or other highly flammable substance storage spaces, rooms housing a fixed internal combustion engine and areas where flammable vapours are likely to be present in the atmosphere.

Note: Places of special fire risk may also be identified in codes of practice or other documents referred to in 1.1 of TGD B in relation to particular building uses.

Protected corridor/lobby - A corridor or lobby, which is adequately protected from fire in adjoining accommodation by fire-resisting construction.

Protected stairway - A stairway, which is adequately protected from fire in the accommodation through which it passes by fire resisting construction and discharges through a final exit to a place of safety.

Storey - means any of the parts into which a building is divided horizontally above or below ground level but excluding any part of a building situated above the level of the roof or in the roof space, or below the level of the lowest floor, which is intended for the protection of a water tank, or lift motor room, or similar use and is not intended for, or adapted to be used for habitable purposes, or as a work room, or as a store room. For the purpose of B1 a storey also includes:

(a) any gallery in an assembly and recreation building; and

(b) any gallery in any other building if its area exceeds half of the space into which it projects.

Storey exit - A final exit, or a doorway opening into a protected stairway, firefighting lobby or external escape route, or a doorway in a compartment wall that is common to two or more buildings (a separating wall).

Travel distance - (unless otherwise specified) The actual distance to be travelled by a person from any point within the floor area to the nearest storey exit, having regard to the layout of walls, partitions and fittings.

METHODS OF MEASUREMENT

(**a) Occupant capacity of a:**

(i) room or storey - is the maximum number of persons it is designed to hold (where this is known) or the number calculated using recognized occupancy load factors from -

$$\frac{\text{area of room or storey } (m^2)}{\text{occupancy load factor}}$$

Note: 'area' excludes stairway enclosures, lifts and sanitary accommodation.

(ii) building or part of a building - is the sum of the number of occupants of the storey's in the building or part.

(b) Travel distance - is by way of the shortest route, which if:

(i) there is fixed seating or other fixed obstructions, is along the centre line of the seat ways and gangways;

(ii) it includes a stairway, is along the pitch line on the centre line of travel.

(c) Width of a:

(i) Doorway - is the clear width when the door or doors are open. Door hardware which does not intrude more than 100mm into this width may be ignored.

Note: It is assumed that the door leaf is free to open to an angle of at least 90°.

(ii) Escape route - is the width at 1,500mm above floor level when defined by walls (handrails fixed to walls which do not protrude more than 100mm into this width may be ignored) or, elsewhere, the minimum width of passage available between any fixed obstructions; and

(iii) Stairway - is the clear width between the walls or balustrades, (strings and handrails intruding not more than 30 mm and 100 mm respectively may be ignored).

APPENDIX 3 PROVISION OF COMPARTMENTATION DETERMINISTIC & COMPARATIVE ANALYSIS

Introduction

As detailed in Section 3.3.1 of this report, the Market building will form a single fire compartment, and the size of the compartment will be within the limits recommended for a Risk Profile B2 building (i.e. single storey building - no limit) in accordance with Section 31.2 and Table 28 of BS 9999:2017.

The Department of Environment, Community and Local Government (DECLG), in their 2011 circular, confirmed their satisfaction for Local Authority Building Control Authorities to consider fire safety strategy designs based on British Standard BS 9999 code guidance, as alternative solutions, as provided for in Section 0.1.4 of TGD B, and stated that designs based on this Code may in general be regarded as acceptable, provided the level of fire safety achieved is adequate to satisfy the requirements of Part B of the Second Schedule to the Building Regulations.

As noted in the DECLG circular, BS9999 provides a more flexible approach to fire safety design than that provided by the more generic guidance of TGD B, through the use of a risk-based approach to fire safety design, taking account of physical factors of the building and human factors of its occupants. It also provides '*an alternative approach to fire safety and can be the only practical way to achieve a satisfactory standard of fire safety in some large and complex buildings….*'.

The market building, which opened in 1892 and is a listed building of significant historical importance, was constructed 100 years before the introduction of the Building Regulations. It is a large, open plan building with a high roof.

Under the requirements of Section B3 of the Building Regulations, the objective of the provision of compartmentation within a building is to prevent rapid fire spread and to *'reduce the chances of a fire becoming large, on the basis that large fires are more dangerous'.*

Technical Guidance Document B (TGD B), published under Article 7 of the Irish Building Regulations (1997) provides guidance in relation to achieving compliance with Part B of the Second Schedule to the Building Regulations. The document provides that, where works are carried out in accordance with the guidance in TGD B this will, *prima facie*, indicate compliance with Part B of the Second Schedule to the Building Regulations.

Although compliance with the recommendations of BS9999:2017 vis-à-vis the provision of fire compartmentation is achieved, to demonstrate that the proposed compartmentation will provide the level of fire safety required to satisfy the requirements of Part B of the Second Schedule to the Building Regulations, both a deterministic analysis and comparative analysis have been carried out, as detailed below.

Deterministic Approach

The deterministic approach, using CFAST modelling, demonstrates the benefits associated with the orientation of the market fire loads, the provision of wide circulation routes between market zones/bays and the existing high roof with permanent open vents in ensuring that a fire within a single market zone/bay will not spread beyond the zone of fire origin to adjacent market zones, therefore satisfying the requirements of Section B3 of the Building Regulations by preventing rapid fire spread and reducing the chances of a fire becoming large.

The analysis incorporates some onerous assumptions regarding fire sizing which ensure that a significant margin of safety is incorporated into the results.

The below assessment assumes a fire within one of the market zones within the building. This is considered reasonable on the basis that the ceiling above each kiosk/stand within this zone will be perforate, therefore facilitating any heat/smoke from a fire to be directed upwards towards the permanently open vents at roof level and limiting the risk of lateral fire spread through downward radiation.

In addition, the amount of combustible material present within each kiosk will be in small quantities and, in the unlikely event of fire, staff/management will have access to the use of portable Fire Extinguishers, where considered safe to control/extinguish the fire.

Background

Fire Growth

When a fire ignites it will spread by flame contact, increasing in area and subsequently increasing the rate of burning. At the early stages of the fire the rate of burning is determined by the amount of heat that is transferred to the surface of the fuel from the flame burning above.

In a compartment, smoke rises from a fire until it meets the ceiling when a smoke layer begins to build downwards. As the smoke layer builds down from the ceiling less entrainment into the plume occurs causing the temperature of the smoke to increase. As the smoke layer increases in temperature, it radiates heat down onto the other combustibles in the compartment increasing the rate of fire growth.

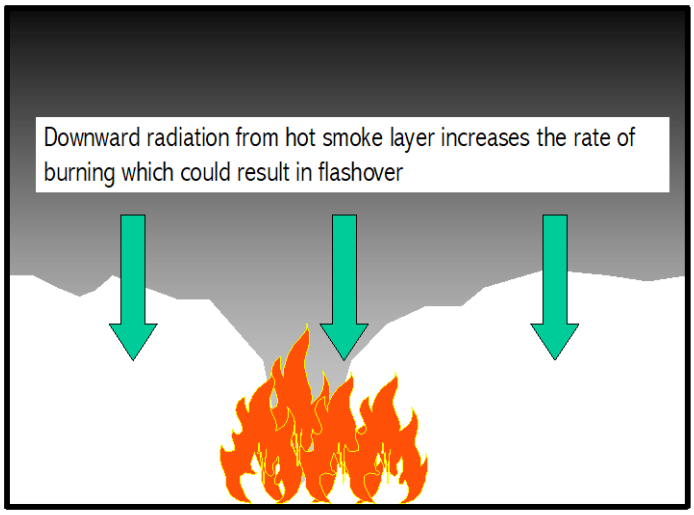


Figure 1: Fire Growth Beneath a Low Ceiling

A fire in the open air, however, will not form a smoke layer and so there will be no downward radiation. The result of this is a slower rate of fire growth than a fire in a compartment with a low ceiling (see Figure 2).

A fire beneath a void or high ceiling space can be compared to a fire in the open air. The smoke will rise to high level and although a smoke layer will form in the roof light there will be no significant downward radiation onto the surrounding combustibles. This is due to the relatively cool temperature of the smoke and the height of the smoke layer base above any combustibles.

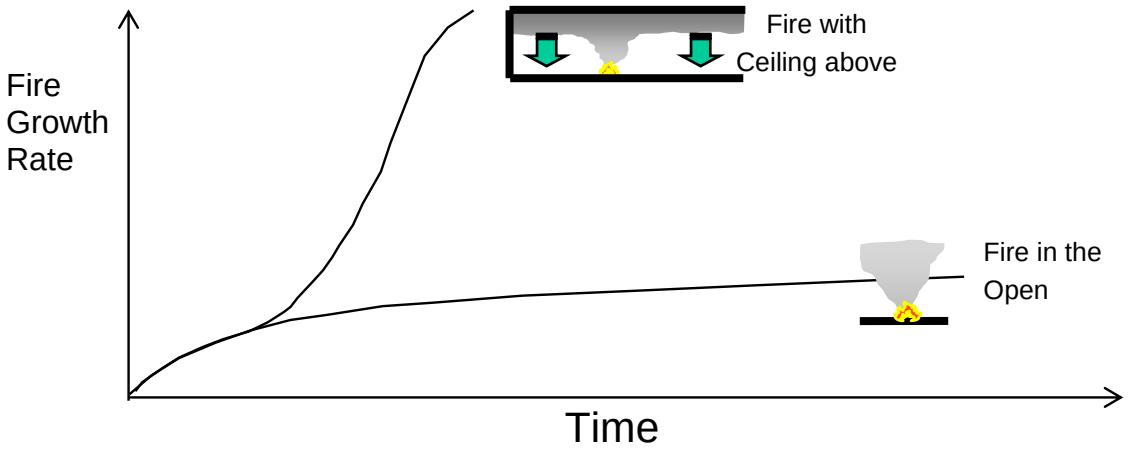


Figure 2: Rate of Fire Growth versus Time

Smoke Production

Conical Plume

When a fire occurs in an open space, such as under a high ceiling space, it will produce hot gases due to combustion. As these gases rise, they will entrain large quantities of cool air. This entrainment, or mixing, is induced by the upward movement of the hot gases, which are replaced by cold air drawn into the fire column.

As the smoke plume rises, it increases in volume as more air is entrained into it and forms the shape of an inverted cone (see Figure 3). In addition to an increase in volume, the air entrained will cool the smoke the further it rises. The amount of entrainment into the plume can be calculated from:

$$m = 0.188 \times P \times Y^{\frac{3}{2}}$$

Where,

m = mass flow into the smoke layer (kg/s)
P = the perimeter of the fire (m)
Y = the height of rise to the base of the smoke layer (m)

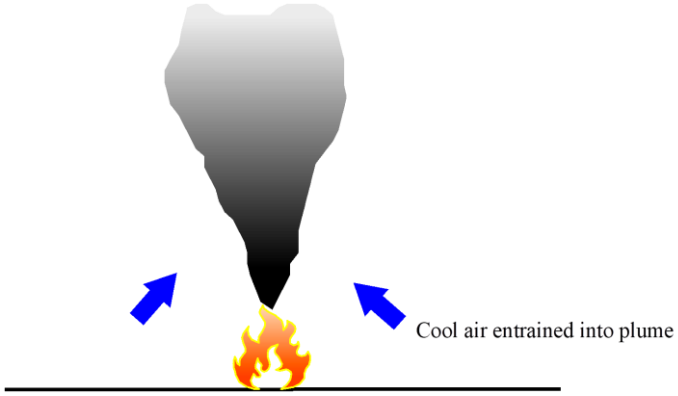


Figure 3: Entrainment into a conical plume

Zone Modelling Software

The model used to carry out the deterministic analysis is CFAST.

The model is a zone model and therefore simplifies smoke movement in a building. The user specifies the fire and its anticipated growth and the building and it's characteristics, as input variables.

Section 7.3.4.2 of PD 7974-0 states: -

Between these two extremes are zone models for smoke spread and other models of similar complexity. These intermediate models generally subdivide the computations into two or three discrete zones and link a number of well-established empirical algorithms together to carry out repeated calculations at defined time steps. This can provide a reasonable simulation of transient conditions but does not provide any indication of the variation of conditions in a zone.'

Section 7.3.4.3 goes on to state: -

'In many cases, hand calculations or intermediate computer models will provide adequate accuracy. This type of model can provide results quickly and simply and are extremely useful where the problem under consideration is consistent with the empirical relationships utilised.'

The model of the proposed building comprises of the main market area only i.e. the large fire compartment.

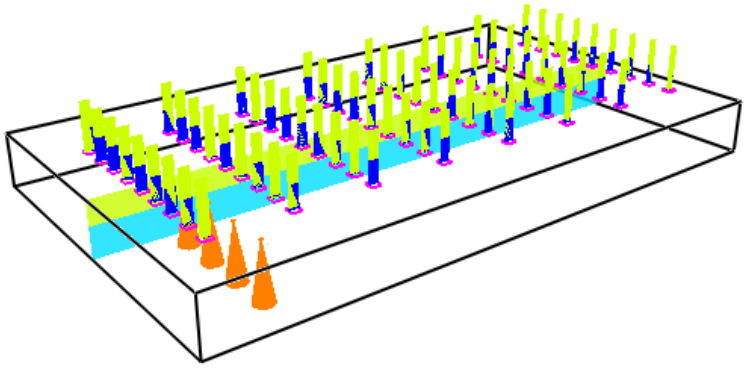


Figure 4: CFAST Model

The model is a simplified imitation of the proposed building as shown above. As the market area can only be a simple block, the more critical dimensions have been chosen as part of the sizing of the model i.e. the mean average ceiling height of the market and its largest width and depth dimension.

Fire Size

Table 6.3 of CIBSE Guide E 2010 gives typical values for heat release rates for various occupancy types.

Table 6.3 Commonly used values of heat release rate[8]

Occupancy	Unit heat release rate, Q_U / kW·m^{-2}
Offices	290
Shops	550
Industrial	260
Hotel rooms	249

Figure 5: Commonly used heat release rates (KW/m^2)

Retail is a very broad purpose group with varying fire load densities and orientations for different types of retail use. The heat release rate figure of 550KW/m^2, as detailed in Figure 5 above, is considered applicable to retail premises/areas containing products of high combustibility whose method of display (railing, racking, shelving, etc.) would promote fire spread through the combustibles, such as clothes shops, newsagents, toy stores, etc.

In the case of the proposed food market, the fire load density would be considerably less, based on the level of combustibility of the produce (i.e. food) and its low-level display within the various kiosks.

Furthermore, where kiosks are to be used for open cooking purposes, these open cooking facilities will be provided with local suppression systems e.g. Ansul, to limit the risk of fire spread to adjacent areas.

Considering the fire load (and heat release rate) within the food market as equivalent to a typical retail unit is an onerous assumption, and it would be considered reasonable to attribute a lower heat release rate to the food market. However, for the purposes of this analysis we have utilised the typical retail heat release rate of 550KW/m^2, which will ensure that a significant margin of safety will be factored into the results.

The food market is divided into 14 no. zones/bays, separated by wide circulation routes, with each zone accommodating approximately 8 individual kiosks/stalls. The largest market zone has an area of 215m^2. However a significant percentage of the total zone will comprise of minimal fire load i.e. circulation space, displays, etc.

Therefore, it is considered reasonable to allocate 70% of the total market area (of 215m^2) as containing the fire load i.e. 150m^2. Based on a heat release rate of 550KW/m^2, a fire size of 82.5MW has been modelled for this analysis.

Again, this fire size is considered onerous and assumes that all the fire load present within the entire market zone (consisting of multiple kiosks) will combust simultaneously at a fast fire growth rate. In reality: -

- The fire will originate within a single kiosk within the market zone, with a limited fire load/area.
- If the fire spreads between kiosks within the market zone, the fire growth within each kiosk will have its own growth and decay phase, which will differ from the other kiosks within the market zone.
- For the purposes of this analysis, a fast fire growth rate has been modelled, which is more applicable to stacked combustibles. As per the recommendations of Table 3 of BS9999:2017, a medium fire growth rate would be more applicable to the food market kiosks.

Therefore, the fire size (i.e. 82.5MW) modelled will ensure that a significant margin of safety will be factored into the results of the analysis.

Fire Location

To simulate a fire enveloping a full market zone/bay, the fire size of 82.5MW has been divided into 4 no. equal fire sizes of 20.6MW each. The fires have been evenly distributed throughout the market zone.

Inlet air

As part of the analysis, we have assumed a worst-case scenario of a fire in the market building when unoccupied, and when all external doors are locked closed. Once the external doors are opened i.e. on arrival of the fire brigade, the introduction of inlet/replacement air via the open doors will increase the efficiency of the natural smoke venting system, resulting in a significant reduction in smoke layer temperatures while maintaining the smoke layer at a greater height above the market floor.

Simulation time

The simulations were run for 60 minutes (3600 seconds).

‘What if’ events

BS7974-0: 2002 states:

`….As part of the hazard assessment process an assessment of "what if events" should be made. The objective is to identify system failures or foreseeable events that might have a significant influence on the outcome of the study…´

Some examples of typical "what if events" are:

- Automatic roof vents fail to operate/open
- combustible displays introduced into sterile areas.
- materials of greater than specified flammability.
- larger than expected fire load / fire growth rate

All of the above 'what if events', that are relevant to this project, were considered as part of the sensitivity analysis. As recommended for a deterministic study, judgement was made as to whether the 'what if' event is likely to significantly affect the overall fire risk. Please see responses below for the 'what if' events listed above:

- The existing roof vents, located in the lantern bays at the apex of each roof bay, are permanently open.
- The sterile areas between market zones are used for circulation/escape purposes and will be kept clear at all times.
- The building will be used for the sale of food produce. As detailed above, the fire size modelled in this analysis is considered more applicable to a retail unit selling clothing, hardware, toys, etc. therefore, a considerable margin of safety is applied to the design fire size to cater for an increase in larger than anticipated fire load.

Results

As part of the deterministic analysis using CFAST modelling as detailed above, we have reviewed the effect of roof height and the provision of permanent vents at roof level on the temperature of smoke within the building and the height to which the smoke layer will descend.

Additionally, we have carried out an assessment as to whether the radiant heat flux from a fire in a Market zone to the opposing zones(s) would promote the spread of fire throughout the building prior to the Fire Service arriving on site.

The following 3 no. building scenarios were modelled: -

- Building mean average height 5m
- Building mean average height 8.8m
- Building mean average height 8.8m complete with approximately 212m^2 of roof venting. **This is the scenario presented by the existing building structure.**

Temperature and Height of Smoke Layer

As detailed above, lateral fire spread occurs when hot smoke from the descending smoke layer radiates heat down onto the combustible materials within the compartment.

Figures 6 and 7 below demonstrate that, in the case of the proposed food market which is provided with a high roof and permanent venting provisions, the maximum temperature of the smoke layer (approximately 320^{0}C) and the minimum height of the smoke layer above floor level (i.e. 3.9m), are both recorded after approximately 510 seconds of the simulation.

Neither the smoke temperature, which is well below the 550^{0}C – 600^{0}C range required for flashover, or the height of the smoke layer recorded at this time are sufficient to promote sufficient downward radiation onto the combustible materials to facilitate the spread of the fire beyond the market zone of fire origin.

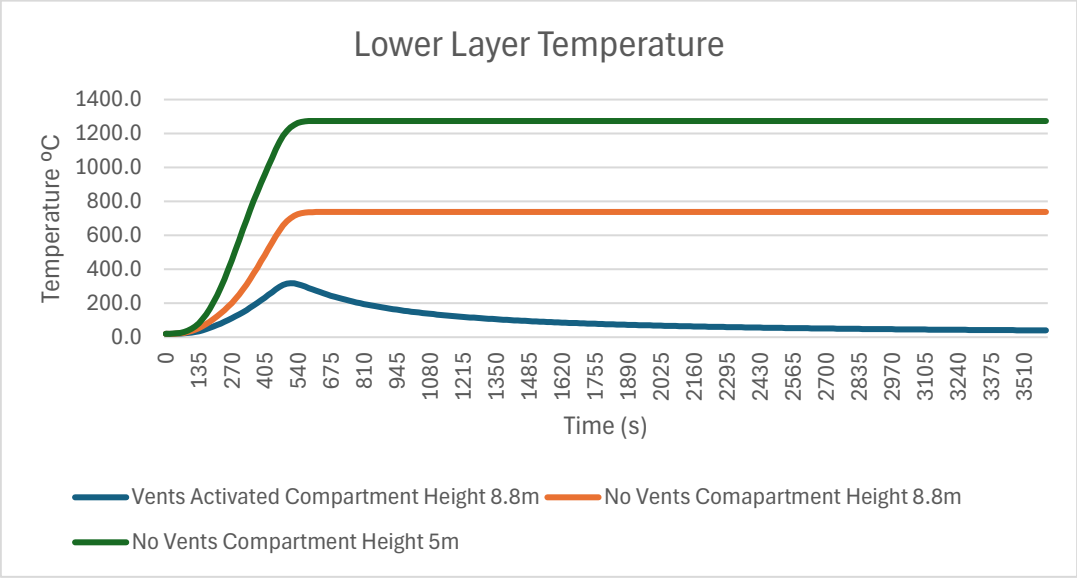


Figure 6: Lower Smoke layer temperature

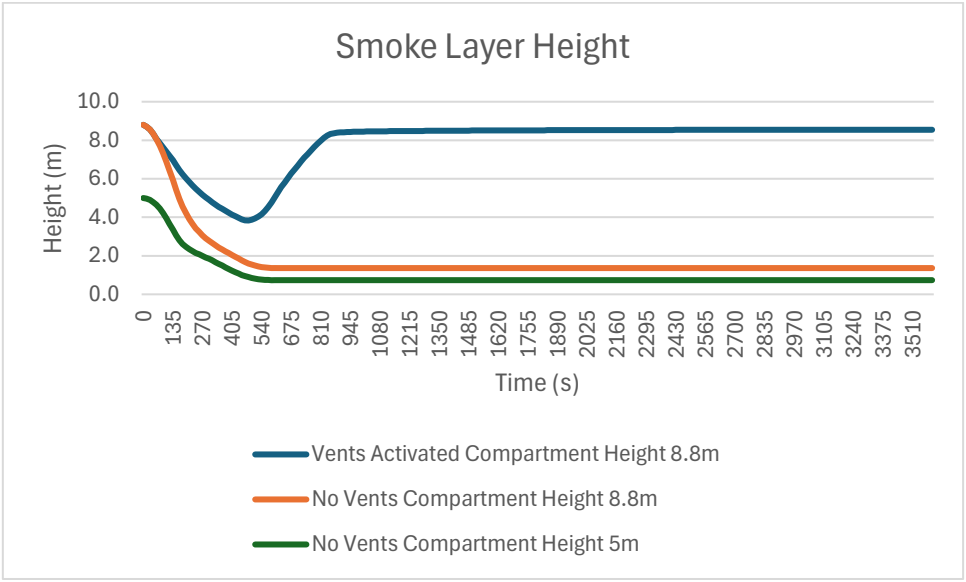


Figure 7: Smoke Layer height

The effect of the roof height and the provision of roof vents on the smoke temperature and clear layer height are clearly demonstrated in the above graphs, were the scenarios involving no venting and a lower roof height are both recorded.

Radiative Flux to opposing bay

As part of the CFAST analysis an assessment of the radiative heat flux from the market zone of fire origin to the opposing market zone(s) was carried out. As part of the CFAST model, a target 'receiver' was set up 4m away from the location of fire origin i.e. the width of the circulation routes to be provided between market zones. The material assigned as the target was corrugated cardboard.

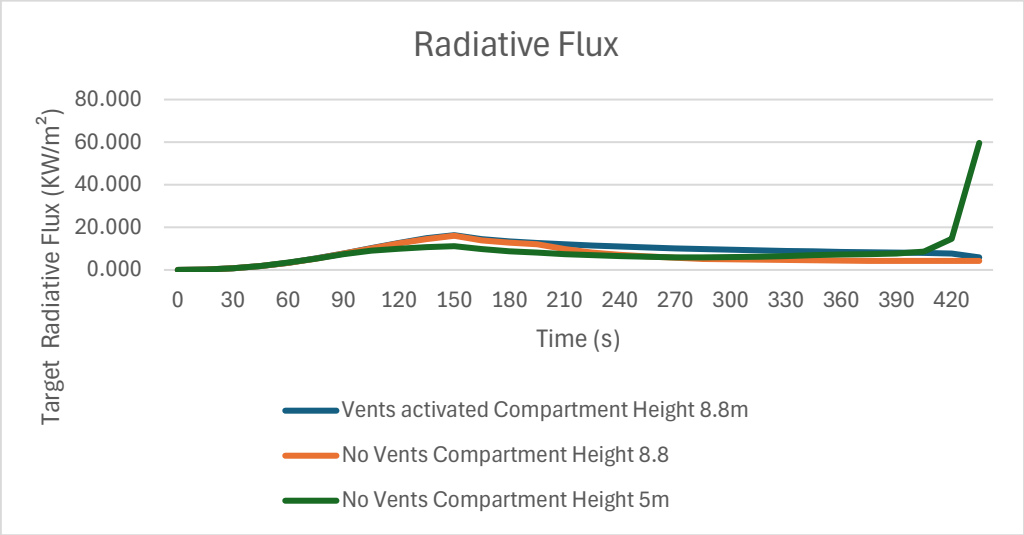


Figure 8: Radiative Heat Flux to receiving target i.e. Cardboard

The intensity of radiation received by an object from a flame is dependent on the separation distance between them. To prevent fire spread, the radiation intensity received must not exceed 12.5kw/m^2 (Buchanan).

However, Drysdale in "An introduction to Fire Dynamics" 2nd edition 1999, reports that 12.5kw/m^2 is the radiation heat flux necessary for volatiles from wood to be ignited by **pilot after prolonged exposure**. This value would be conservative as an open pilot flame local to the receiving item needs to be present to achieve flame spread.

Therefore, a higher radiant heat flux of 20kw/m^2 is required to cause non piloted ignition, and this figure is used as part of this assessment.

As noted in Figure 8 above, the provision of a high roof (8.8m) complete with vents, results in the radiant heat flux reaching a peak of 16.3kw/m^2 after 150 seconds, which is below the threshold for non-piloted ignition. Therefore, fire spread between market zones due to lateral radiation will also not occur and the fire will not spread beyond the market zone of fire origin.

The threshold is also not exceeded where the building mean average height is 8.8m with no venting. Where the mean height is 5m, the 20kw/m^2 is exceeded after 435s. Hence why we have concluded the results at this time.

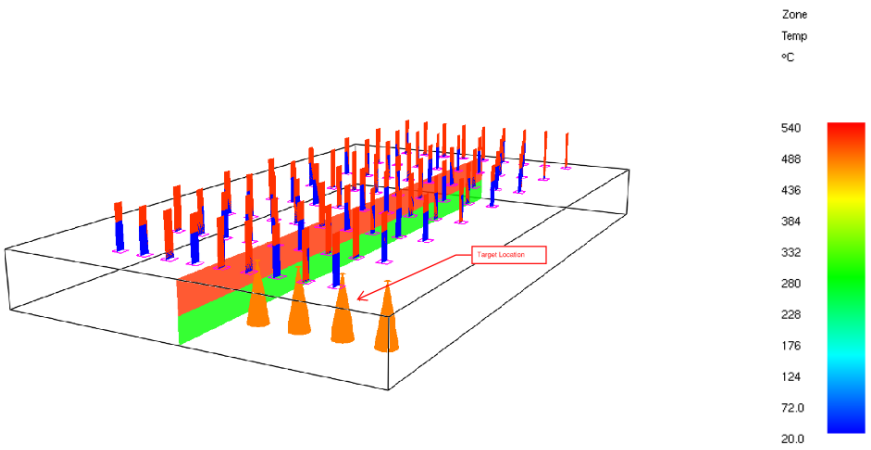


Figure 9: Target location in conjunction with Fire location

Comparative Analysis

A comparative analysis was also carried out to demonstrate how the proposed compartmentation for the building, as provided in accordance with BS9999:2017 guidance and validated by the deterministic analysis detailed above, would provide a level of fire safety equivalent to Technical Guidance Document B 2006 + A1:2020, whose recommendations are deemed to satisfy the requirements of Part B of the Second Schedule to the Building Regulations.

TGD B Compliant Scenario

The following single storey retail unit would comply with the recommendations of Technical Guidance Document B for a single fire compartment: -

- Floor Area of retail Unit/Compartment – 4,000m^2
- Ceiling height – 3.5m
- Volume of Retail Unit/Compartment – 14,000m^3 (less than code recommended limit of 20,000m^3)
- Distance between retail displays – 1.2m (allowing circulation between displays)
- Heat release rate - 550KW/m^2 (HRR for typical retail unit).
- Height of fire load – 3m (floor to ceiling racking/shelving)
- **Area of fire load within unit/compartment – 2,800m^2 (Note 1)**
- **Maximum fire size – 1,540MW (Note 2)**

Note 1: Considering 15% of the floor area of the retail unit as back of house/storage, which would be expected to be fire separated from the main sales floor, and a further 15% as comprising of circulation space, the area of the sales floor which would comprise of a fire load would be 2,800m^2 (i.e. 4,000m^2 x 0.70).

Note 2: Based on a heat release rate of 550KW/m^2 the maximum fire size within a code compliant retail compartment would be 1,540MW.

Furthermore, due to the low roof height within the code compliant retail compartment and the minimal distance between displays (for circulation), fire spread due to downward and lateral radiation would likely result in full involvement of all combustible materials in the fire i.e. flashover.

Proposed Food Market Scenario

- Floor Area of Market/Compartment – 6,000m^2
- Ceiling height (average) – 8.8m
- Volume of Retail Unit/Compartment – 52,800m^3
- Distance between retail displays – 4m (width of circulation routes)
- Heat release rate - 550KW/m^2 (HRR considered onerous for a food market).
- Height of fire load – 3m (height of kiosks/stalls)
- **Area of fire load within unit/compartment – 150m^2 (Note 1)**
- **Maximum fire size – 82.5MW (Note 2)**

Note 1: Considering 70% of the floor area of the largest market zone (of 215m^2) as containing the fire load i.e. 150m^2.

Based on the results of the deterministic analysis/CFAST modelling, and due to the high roof complete with permanent vents, the fire will not spread beyond the market zone of fire origin.

Note 2: Based on a heat release rate of 550KW/m^2 the maximum fire size within the market compartment would be 82.5MW.

The above comparative analysis demonstrates that both the actual area of the fire load and the maximum fire size within the code compliant retail compartment are multiples of that within the Food market compartment.

Conclusions

- Under the requirements of Section B3 of the Building Regulations, the objective of the provision of compartmentation within a building is to prevent rapid fire spread and to *'reduce the chances of a fire becoming large, on the basis that large fires are more dangerous'.*
- As noted in the DECLG's 2011 circular, Technical Guidance Document B (TGD B), published under Article 7 of the Irish Building Regulations (1997) provides guidance in relation to achieving compliance with Part B of the Second Schedule to the Building Regulations. The document provides that, where works are carried out in accordance with the guidance in TGD B this will, *prima facie*, indicate compliance with Part B of the Second Schedule to the Building Regulations.
- The deterministic and comparative analysis detailed above demonstrates the benefits associated with the orientation of the market fire loads, the provision of wide circulation routes between market zones/bays and the existing high roof complete with permanent open vents in ensuring that a fire within a single market zone/bay will not spread beyond the zone of fire origin to adjacent market zones.
- The results of the deterministic and comparative analysis demonstrate that both the actual area of the fire load and the maximum fire size within a TGD B compliant retail compartment are multiples of that within the Food market compartment.
- Therefore, if compliance with the guidance in TGD B will, *prima facie*, indicate compliance with Part B of the Second Schedule to the Building, then the above deterministic and comparative analysis have demonstrated that the proposed compartmentation will provide a greater level of fire safety than that provided by TGD B guidance, therefore satisfying the requirements of Part B of the Second Schedule to the Building Regulations
- The deterministic and comparative analysis also validate the recommendations of Section 31.2 and Table 28 of BS 9999:2017, which permit a single fire compartment within the Food market building.

APPENDIX 4 CALCULATION OF FEE

The fee for the proposed Fire Safety Certificate is based on a standard rate of €2.90/m^2 of floor area. For a floor area of 6,706m^2 the application fee is €12,500 (i.e., the maximum fee).

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