

# An Introduction to Fire Engineering and Integration with Building Services. Miller Hannah.

HOARE LEA - FIRE ENGINEERING

CIBSE SOUTH WALES  
(23<sup>RD</sup> OCTOBER 2019)



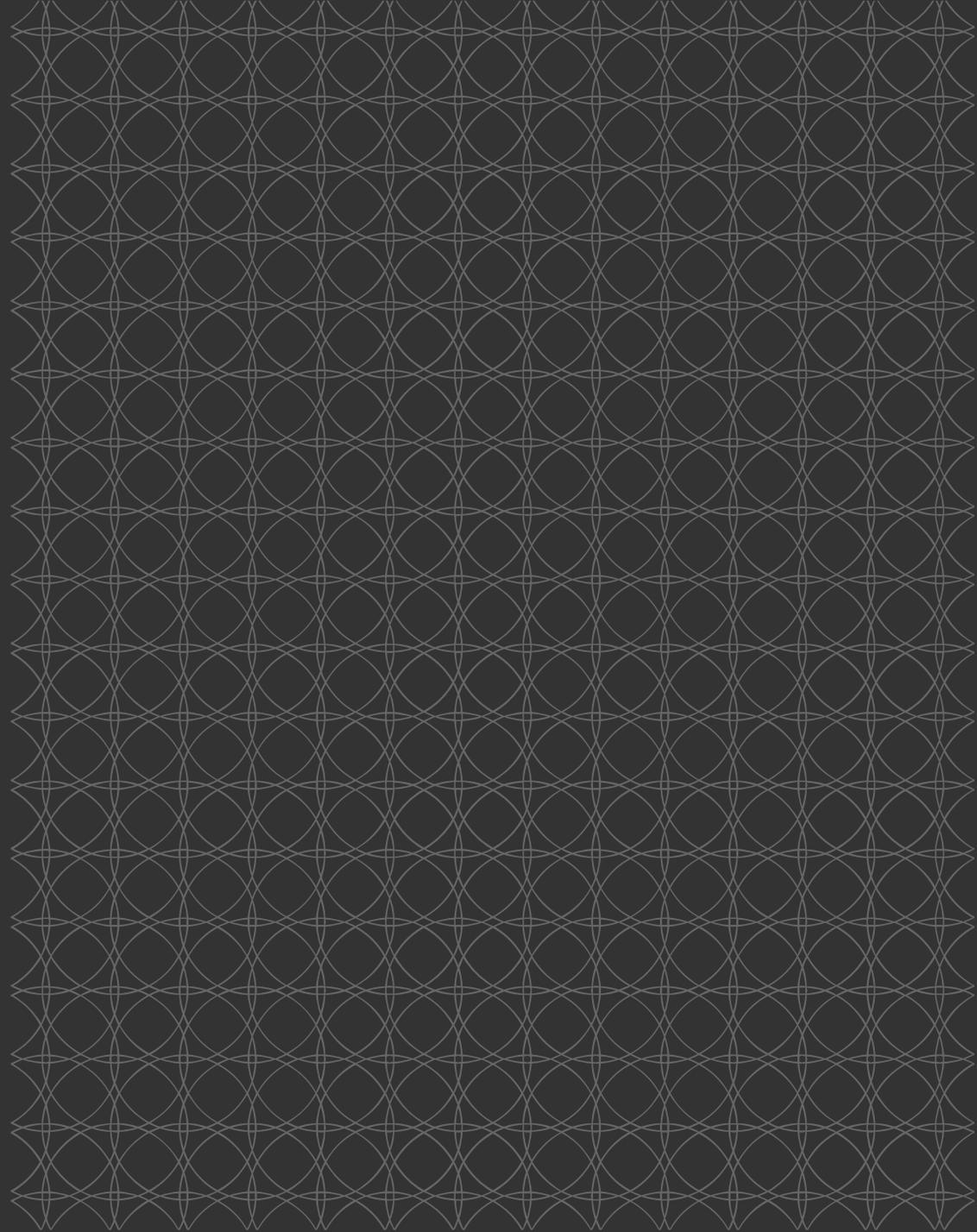
# Introduction.

## What we will cover.

- **Introduction to Hoare Lea.**
- **Introduction to Hoare Lea's Fire Engineering Team.**
- **What is Fire Engineering?**
- **Why is Fire Engineering Important?**
- **What do we do?**
- **Integration with Building Services.**
- **Case Study (Qatar 2022 FIFA World Cup Stadium).**

HOARE LEA 

# Introduction to Hoare Lea.



# Delivering a quality service for over 150 years.



**We only do what we can do well.**  
**Acoustics. Air Quality. Audiovisual.**  
**Building Physics. Digital Engineering.**  
**Expert Witness. Façade Access. Fire Engineering.**  
**Intelligent Buildings. Lighting Design. MEP.**  
**Operational Engineering. Performance.**  
**Property Services. Research & Development.**  
**Security. Sustainability. Utilities & Energy**  
**Infrastructure. Vertical Transportation.**  
**Vibration.**

# Bringing you sector specific knowledge and capability.

Arts, Culture and Heritage



Courts and Emergency



Data Centre and Mission Critical



Defence



Distribution



Education



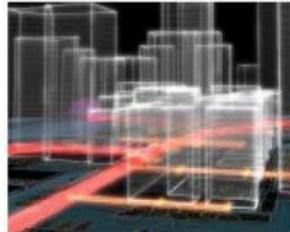
Healthcare



Hotels and Resorts



Infrastructure and Energy



Leisure



Manufacturing and Process



Prisons



Residential



Retail



Science and Research



Sport



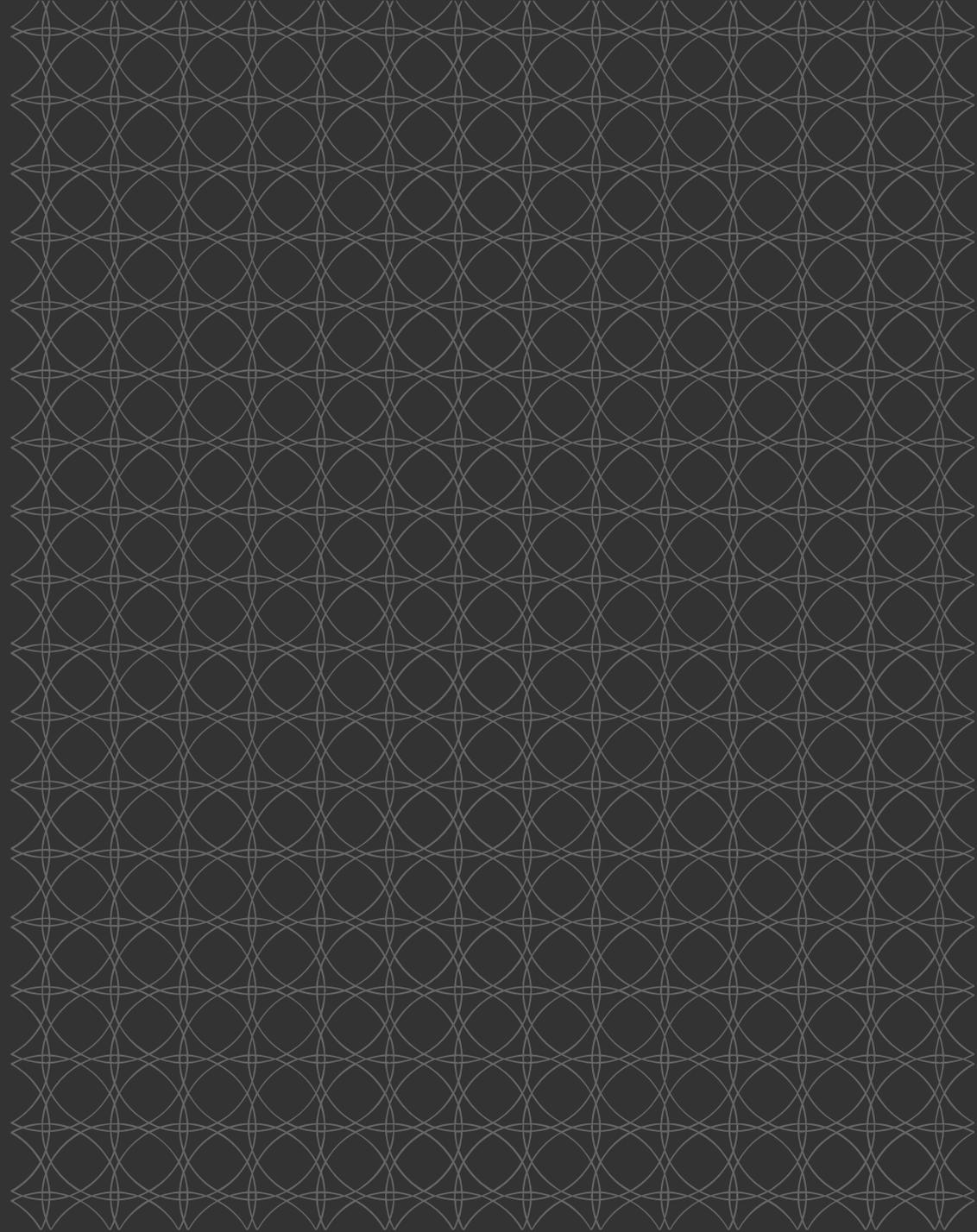
Transport



Workplace



# Introduction to Hoare Lea's Fire Engineering Team.



HOARE LEA (H.)

# Hoare Lea Fire.

Our team.



# What is Fire Engineering?

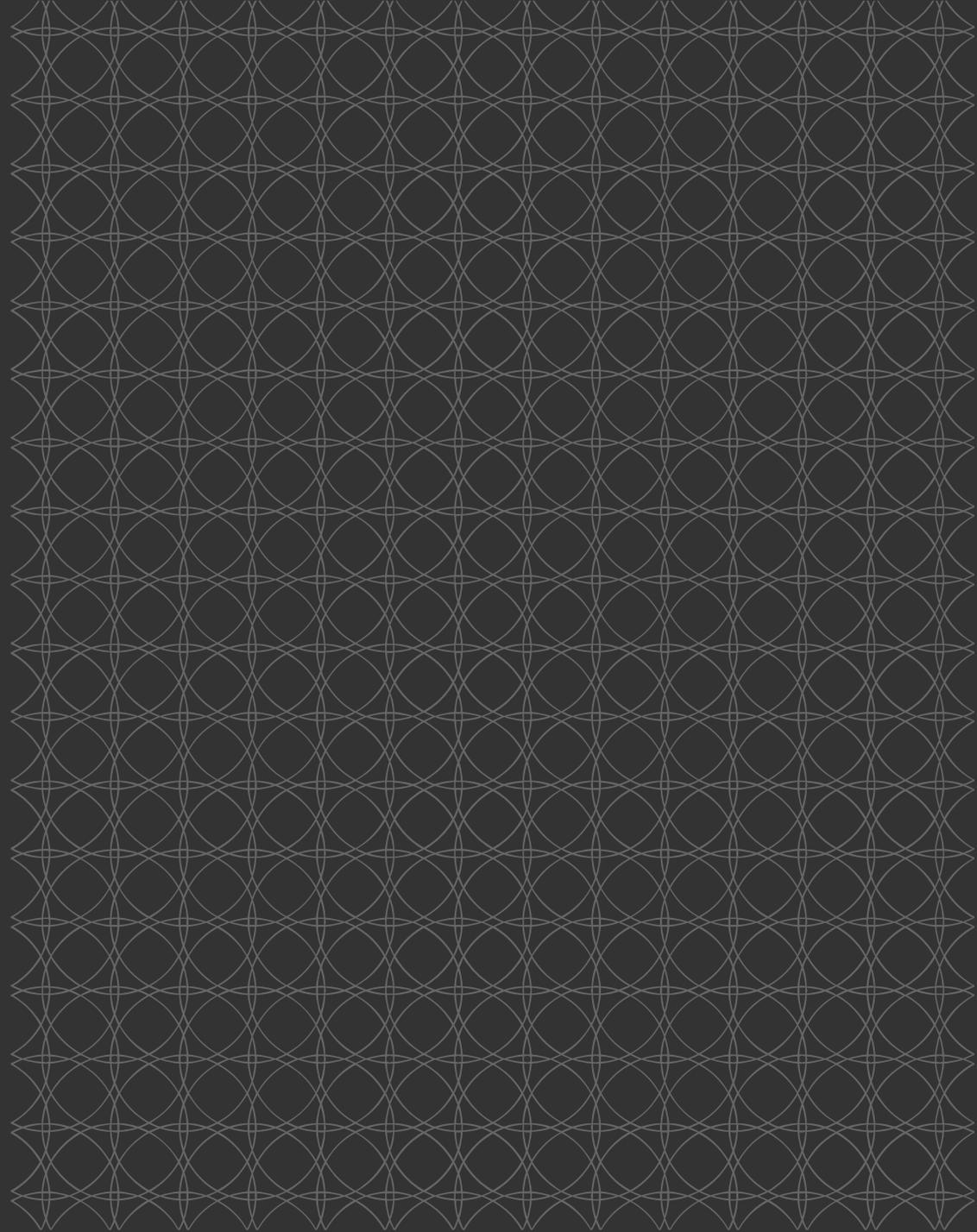


*“Fire Engineering is the application of scientific and engineering principles, rules [Codes], and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire.”*

INSTITUTE OF FIRE ENGINEERS



# Why is Fire Engineering Important?



# Historic Fire Events

## Great Fire of London (1666)



**Deaths: 6**

# Historic Fire Events

## Bradford FC (1985)



**Deaths: 58**

# Historic Fire Events

## Kings Cross Underground Fire (1987)



**Deaths: 31**

# Historic Fire Events

## Lakanal House London (2007)



**Deaths: 6**

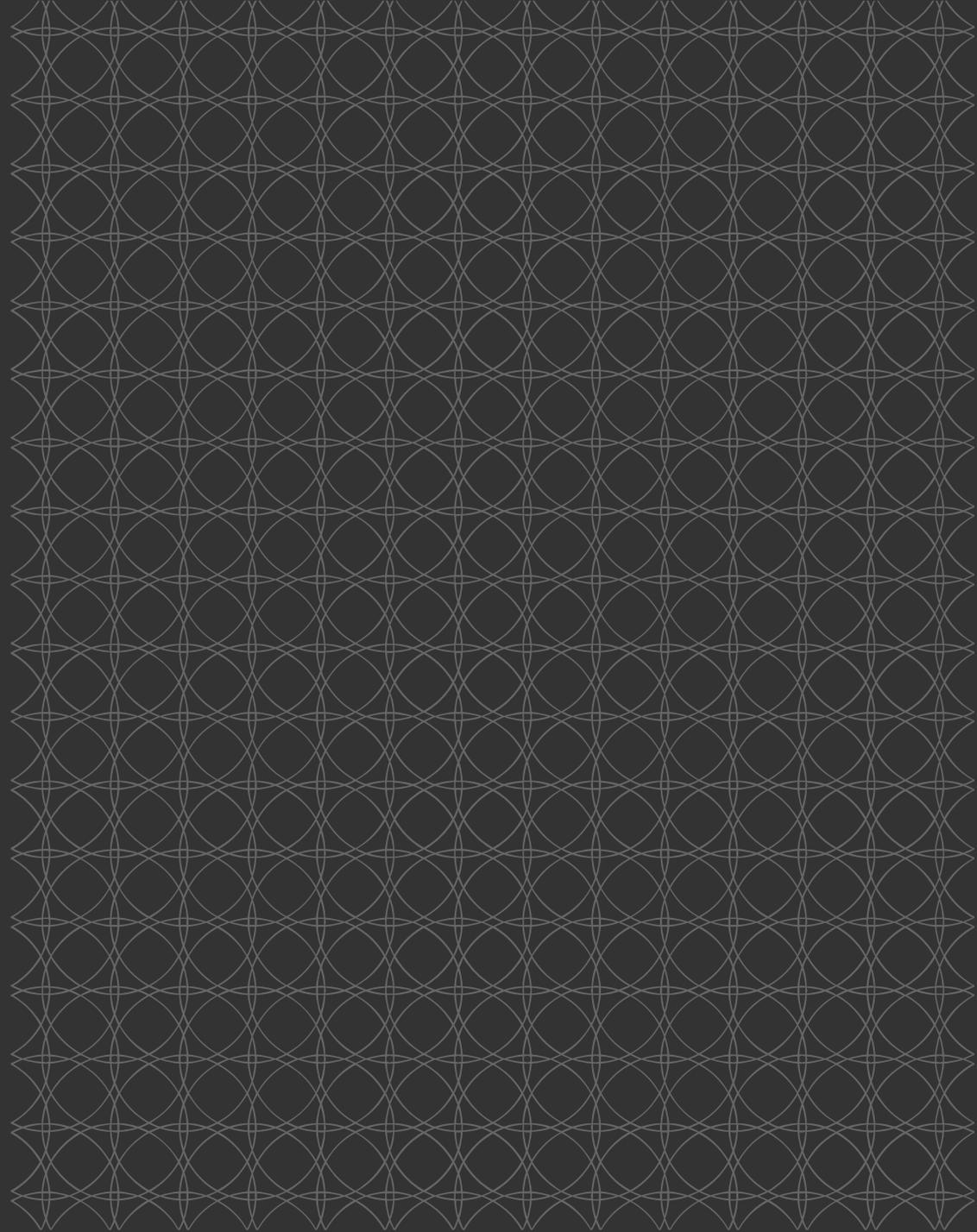
# Historic Fire Events

## Grenfell Tower London (2017)



**Deaths >70**

# What do we do?



# What do we do?

## FIRE SAFETY ENGINEERING.

*“Fire Safety Engineering can provide an alternative approach to fire safety. It may be the only practical way to achieve a satisfactory standard of fire safety in some large and complex buildings and in buildings containing different uses.”*

PRESCRIPTIVE GUIDANCE



Approved Document B  
(2006 Edition)

HM Government

The Building Regulations 2010

Fire safety

B

APPROVED DOCUMENT

### Volume 2: Buildings other than dwellings

Requirement B1: Means of warning and escape  
Requirement B2: Internal fire spread (linings)  
Requirement B3: Internal fire spread (structure)  
Requirement B4: External fire spread  
Requirement B5: Access and facilities for the fire service  
Regulations: 6(3), 7(2) and 38

2019 edition – for use in England

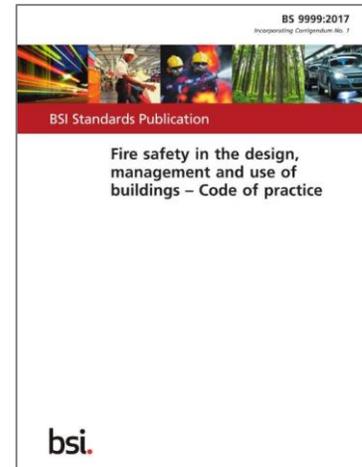
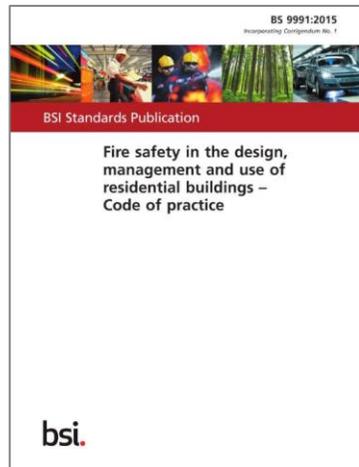
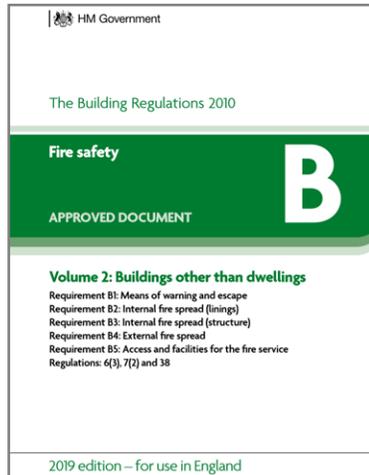
# How do we do it?

## Building Regulations (2010)

Approved Document B  
'Fire Safety'  
(England)

British Standards  
BS 9991 & BS 9999

Fire Engineering  
Solution

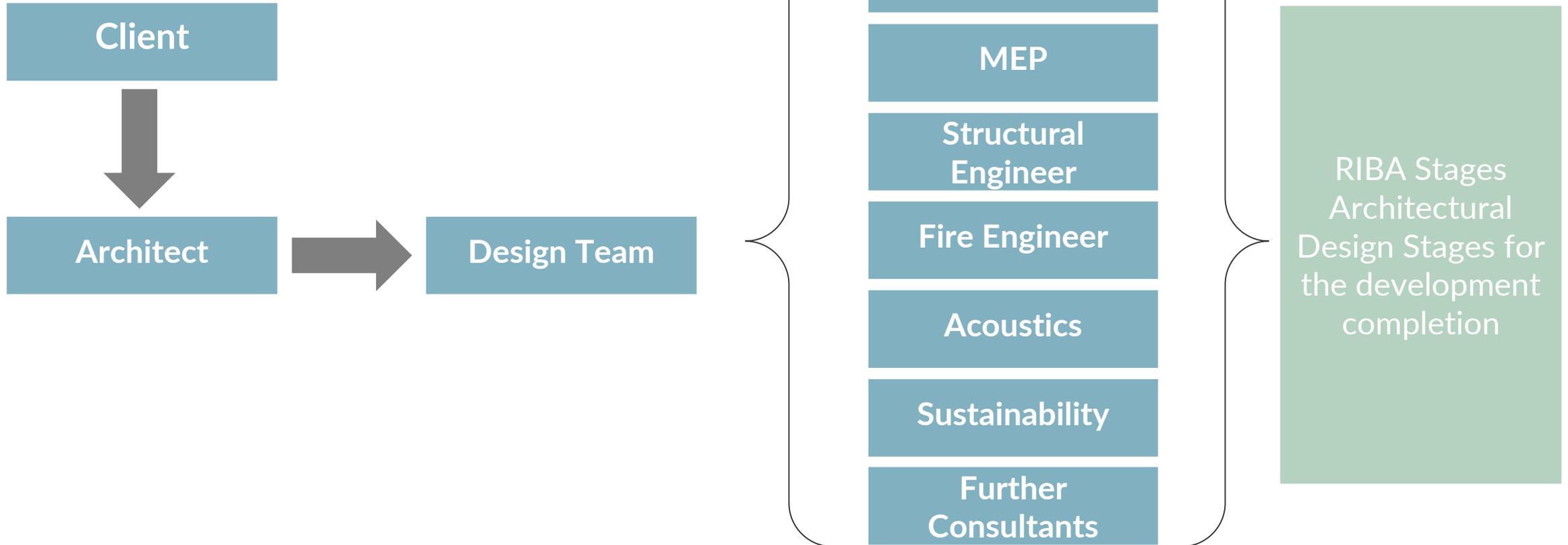


Fire Engineering  
Principles  
BS 7974 & CIBSE E

Fire Dynamics Human  
Behaviour  
Thermodynamics

# Our Role.

Liaising with the design team and developing Fire Safety Strategies to satisfy the Building Regulation requirements.



# Our Role – Developing the Fire Safety Strategy.



RIBA  
Plan of  
Work  
2013

RIBA 

The RIBA Plan of Work 2013 organises the process of briefing, designing, constructing, maintaining, operating and using building projects into a number of key stages. The content of stages may vary or overlap to suit specific project requirements. The RIBA Plan of Work 2013 should be used solely as guidance for the preparation of detailed professional services contracts and building contracts.

[www.ribaplanofwork.com](http://www.ribaplanofwork.com)

	0	1	2	3	4	5	6	7
<b>Stages</b>								
<b>Tasks</b>	<b>Strategic Definition</b>	<b>Preparation and Brief</b>	<b>Concept Design</b>	<b>Developed Design</b>	<b>Technical Design</b>	<b>Construction</b>	<b>Handover and Close Out</b>	<b>In Use</b>
<b>Core Objectives</b>	Identify client's <b>Business Case</b> and <b>Strategic Brief</b> and other core project requirements.	Develop <b>Project Objectives</b> , including <b>Quality Objectives</b> and <b>Project Outcomes</b> , <b>Sustainability Aspirations</b> , <b>Project Budget</b> , other parameters or constraints and develop <b>Initial Project Brief</b> . Undertake <b>Feasibility Studies</b> and review of <b>Site Information</b> .	Prepare <b>Concept Design</b> , including outline proposals for structural design, building services systems, outline specifications and preliminary <b>Cost Information</b> along with relevant <b>Project Strategies</b> in accordance with <b>Design Programme</b> . Agree alterations to brief and issue <b>Final Project Brief</b> .	Prepare <b>Developed Design</b> , including coordinated and updated proposals for structural design, building services systems, outline specifications, <b>Cost Information</b> and <b>Project Strategies</b> in accordance with <b>Design Programme</b> .	Prepare <b>Technical Design</b> in accordance with <b>Design Responsibility Matrix</b> and <b>Project Strategies</b> to include all architectural, structural and building services information, specialist subcontractor design and specifications, in accordance with <b>Design Programme</b> .	Offsite manufacturing and onsite <b>Construction</b> in accordance with <b>Construction Programme</b> and resolution of <b>Design Queries</b> from site as they arise.	Handover of building and conclusion of <b>Building Contract</b> .	Undertake <b>In Use</b> services in accordance with <b>Schedule of Services</b> .

# What's in the Fire Safety Strategy?

Fire Alarm and  
Detection

Means of Escape

Smoke Control  
Requirements

Linings  
Requirements

Structural Fire  
Resistance

Fire  
Compartmentation

Sprinkler  
Requirements

External Fire  
Spread

Fire Service Access

Fire Management

CFD Modelling

Evacuation  
Modelling

# What's in the Fire Safety Strategy?

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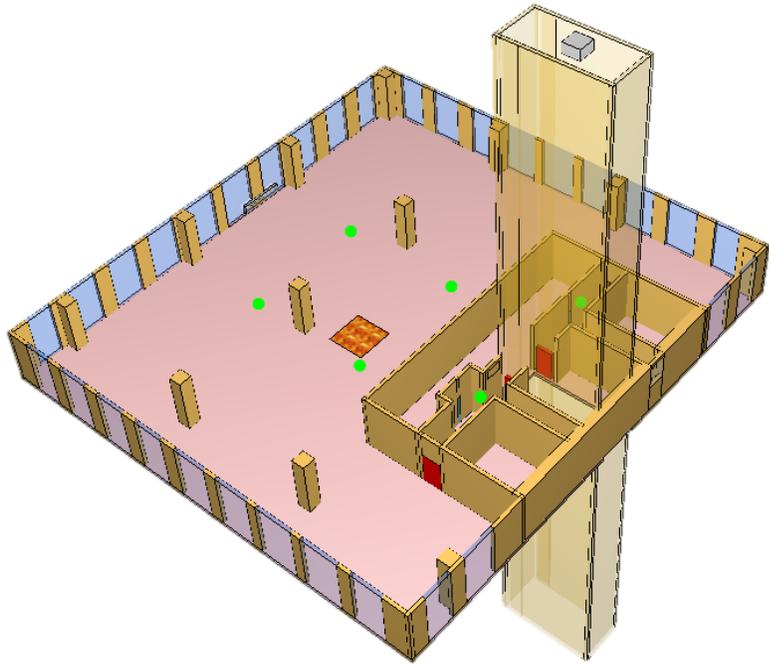
Fire Service Access

Fire Management

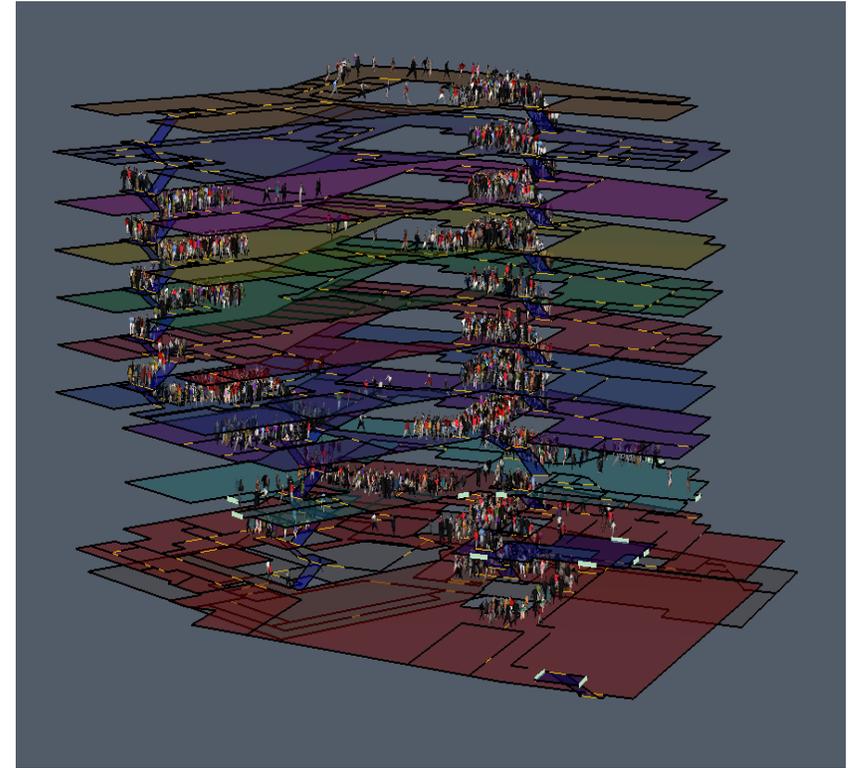
CFD Modelling

Evacuation  
Modelling

# What's in the Fire Safety Strategy?

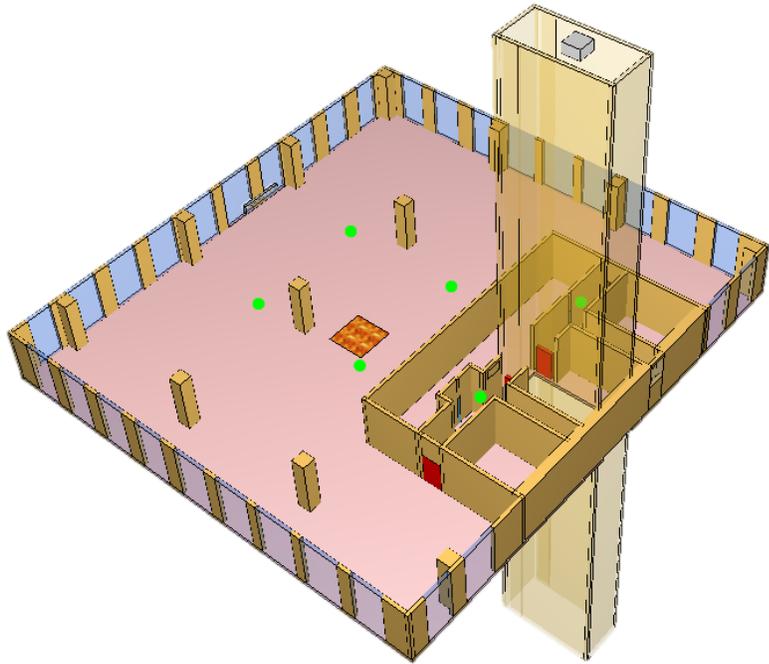


CFD modelling

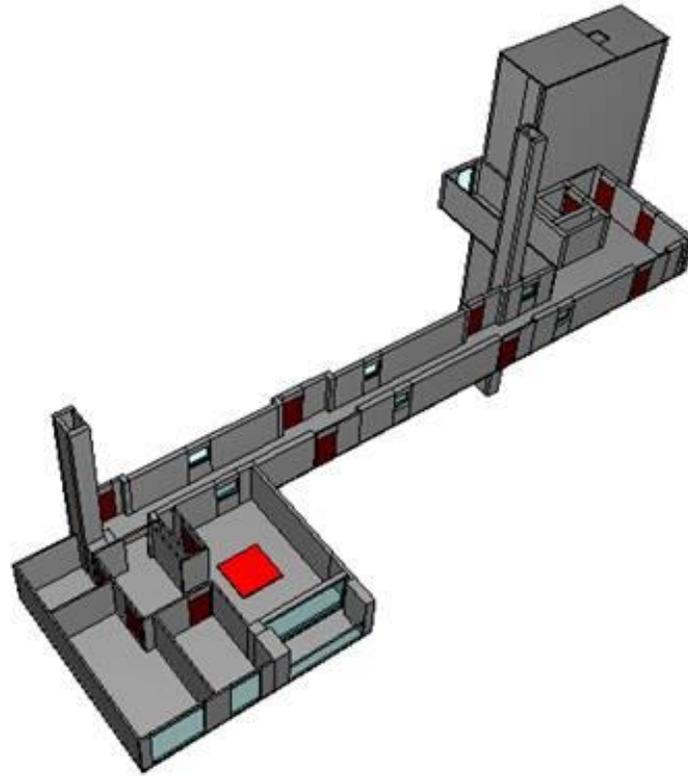


Evacuation modelling

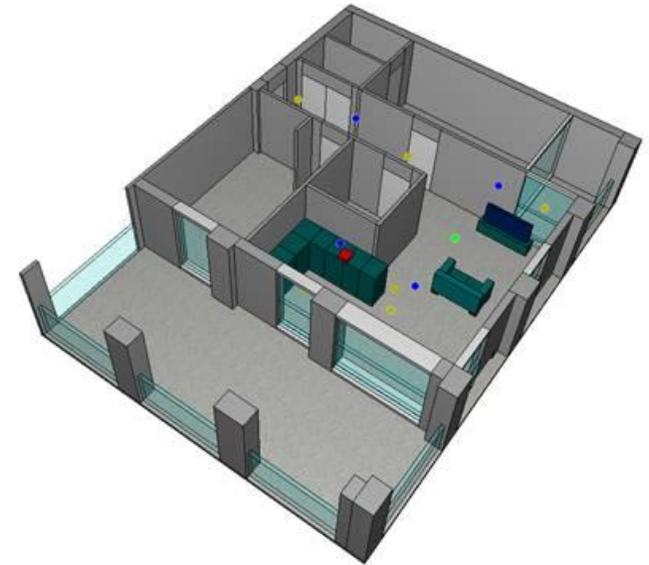
# CFD Modelling.



Single Stair Buildings

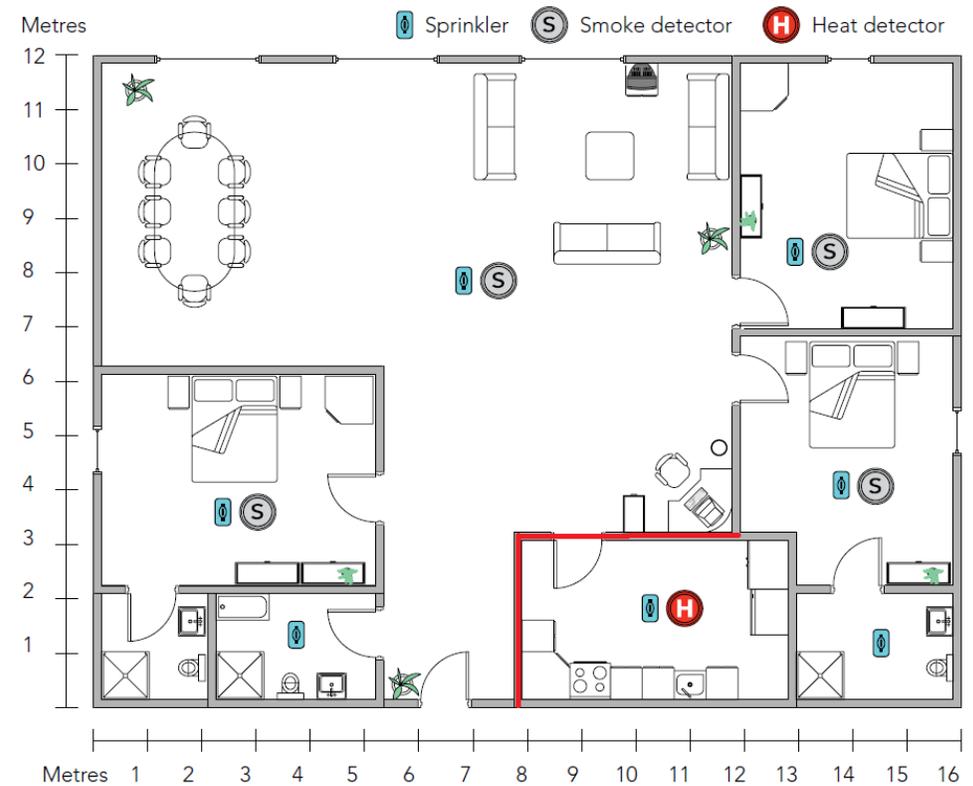
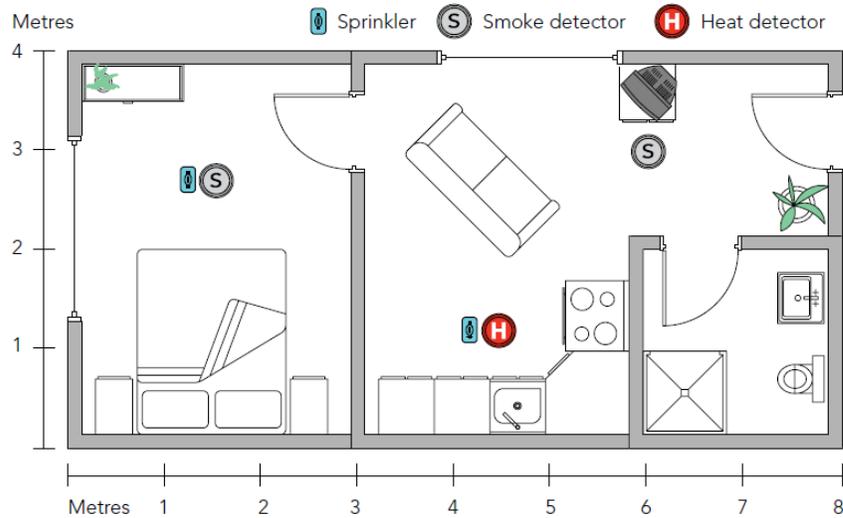


Residential Common  
Corridors



Open-plan  
Apartments

# Internal Apartment Layouts. Code Compliant.



# Internal Apartment Layouts. Fire Engineered.

## CFD Tenability Criteria:

- Temperature.
- Radiative Heat Flux (RHF).
- Fractional Effective Dose (FED).
- Visibility.



# Integration with Building Services.



# Integration with Building Services.

**We work on projects of all sizes and complexities, and the same issues keep occurring...**

- Relevance of the fire safety strategy (Please, please – read it!)
- Services located within, or accessed from, firefighting shafts (Don't do it!)
- Ducts and Dampers (Don't just provide fusible link everywhere)
- Fire safety issues within basements (recognise the possible implications)
- International projects (not every project is to British Standards – follow local guidance)

# **THE Most Common Error... The Fire Strategy Has Not Been Followed!**

You have probably worked on numerous schemes that have a fire strategy – however, do you always read the fire strategy??

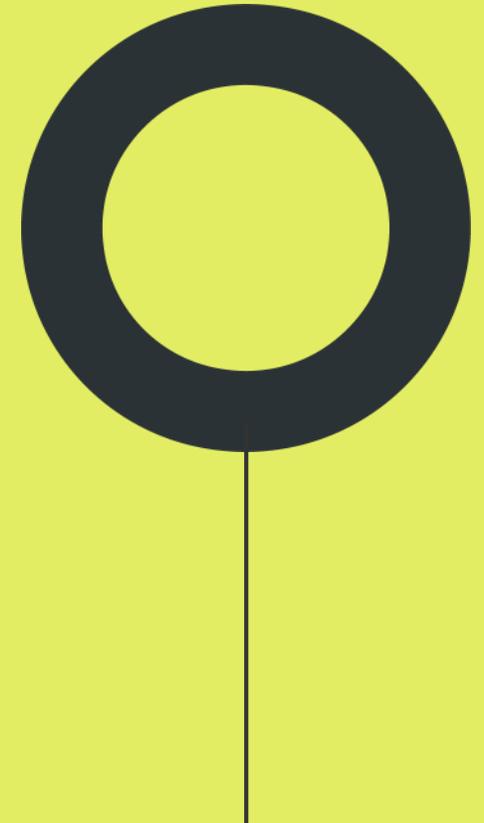
**PLEASE READ IT, AND ENSURE  
YOU UNDERSTAND IT!**

It might be boring, but there are often some key issues described in there.

# THE Most Common Error – The Fire Strategy Has Not Been Followed!

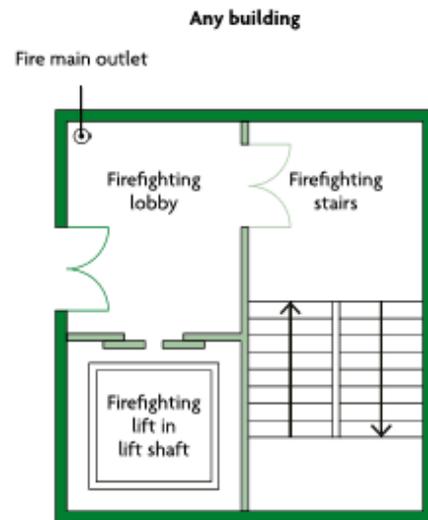
- The fire strategy is the document that Building Control and the Fire Service approve. **They would expect the detailed design to be in accordance with the Fire Strategy.**
- The fire strategy **will not** generally include lots of ‘nice to haves’ – if it states that sprinklers, smoke control, AFD or fire mains are required, **then they are required!**
- If there are any issues with the fire strategy proposals **raise it at an early stage with the fire engineer – don’t ignore it!**

# Firefighting Shafts.



# Firefighting Shafts.

- A firefighting shaft is a 'special' type of stair and lobby (sometimes including a lift).
- Characterised by the provision smoke ventilation to the stair and lobby, enhanced levels of fire resistance to the walls enclosing the shaft, and also the provision of a fire main (e.g. either wet or dry).



- These are generally required in buildings >18m in height, or in some buildings >7.5m in height, or with large or deep basements.
- If in doubt if a stair/lobby is within a firefighting shaft – read the fire strategy!

*“Only services associated with the firefighting shaft should pass through or be contained within the firefighting shaft. A firefighting shaft should not contain any cupboards or provide access to service shafts serving the remainder of the building”*

BS 9999  
SECTION 20.2.3



# Services within Fire Fighting Shafts.

## Restrictions on services.

### Permitted:

- FF lift / lighting power supplies.
- Disabled evac comms wiring.
- Fire alarm cabling.
- Smoke ventilation ducts that serve the firefighting shaft (e.g. pressurisation ducts).
- Sanitary accommodation.

# Services within Fire Fighting Shafts.

## Restrictions on services.

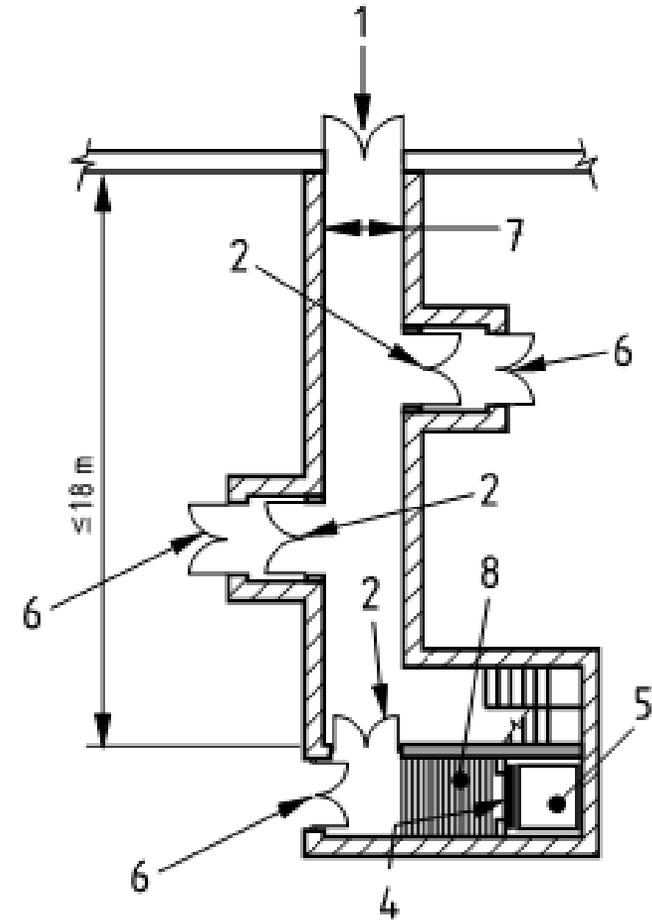
### Not Permitted:

- Air conditioning / vent ducts.
- Gas pipework.
- Power supplies for the rest of the building.
- Cloakrooms, portable heating etc.

# Services within Fire Fighting Shafts.

## Restrictions on services.

Some FF shafts are accessed via a 'corridor' at ground level. The same restrictions on services apply to the 'corridor' as well.

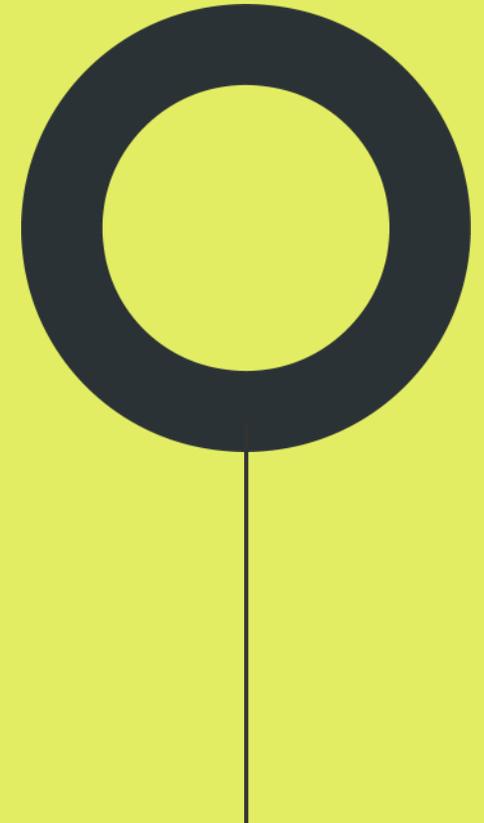


Access via a corridor

# Whilst we're on the subject to Firefighting Shafts...

- Remember that firefighting lifts **should not be used as goods/services lifts** (and indeed such lifts should not be located within FF shafts).
- Fire mains (e.g. dry or wet risers) should be located in the **stair** within a **residential** firefighting shaft, but within the firefighting **lobby** in most **other building** types (there are always exceptions – ask the fire engineer if in doubt).
- The fire main outlet needs to be located such that it **doesn't affect the ability to open a door when the hose is connected and charged with water**. Also need to minimise risk of water spray onto the FF lifts
- **Any variation from the guidance needs to be justified** (sometimes it can be, if you know a good fire engineer...)

# Ducts and Dampers.



# Introduction to Dampers.

Not all dampers are just fire dampers, there are two classifications of dampers:

- Fire dampers ('E' classification)
- Fire and smoke dampers ('ES' classification)

'ES' dampers are normally smoke detection activated.

The selection of the correct damper is undertaken by the M&E consultant, **not the fire engineer...** However, we can help.

*“We can run ductwork everywhere – we just need to ensure we put a fusible link operated fire damper where the duct passes through a fire resisting wall...”*

MECHANICAL ENGINEER  
2019



*“We can run ducts work everywhere – we just need to ensure we put a fusible link operated fire damper where the duct passes through a fire resisting wall.”*

**WRONG**

MECHANICAL ENGINEER  
2019



## 'E' Dampers (Fire Dampers).

- These are normally operated by a fusible link. This 'fails' at a certain temperature which allows the damper to close (~72°C).
- The fire may have developed significantly, and produced large volumes of smoke before the dampers close.
- It is questionable whether these dampers will ever close in a sprinklered building.
- These dampers only prevent Fire Spread (not smoke) – even when they close.



# 'ES' Dampers (Fire and Smoke Dampers).

- These dampers serve to minimise the risk of Fire **and** Smoke spread.
- In the closed position they limit the spread of smoke through the duct more than a 'E' fire damper.
- However, limiting the spread of smoke when closed is useless if it takes too long to close.
- These are provided with a motor which allows the damper to close **on smoke detection** – (generally configured to be powered open and spring closed, and fitted with a fusible link).



# When do we need to provide F&S dampers?

- Broadly speaking, **Fire and Smoke (ES) dampers** are required to **protect escape routes**. **Fire dampers (E)** are to prevent **fire spread only** (this is not adequate for means of escape). **It is the smoke that kills!**
- The provision of **fire resisting ducts** may be an alternative to the provision of fire and smoke dampers (depending where the ventilation openings are located).
- May need fire and smoke resistant **transfer grilles** (activated on smoke detection) if they are located along escape routes.

*“We have a rigid steel duct, so it must be fire resisting...”*

MECHANICAL ENGINEER  
2019



*“We have a rigid steel duct, so it must be fire resisting...”*

**WRONG**

MECHANICAL ENGINEER  
2019



# To F&S Damper or Not to F&S Damper? – Quick summary.

- AD-B and BS9999 are provided with contradictions – be wary!
- Ducts passing through a stair should be fire resisting – ducts serving stairs should not also serve other areas (*although one section of AD-B suggests that ducts should not be located within stairs at all*).
- Ducts passing through (but not serving) a protected corridor or lobby should be fire resisting (*although ES dampers activated on detection may be acceptable*).
- Escape corridors provided with central sub-dividing fire doors may require fire and smoke dampers where the ducts penetrate the corridor sub-division.
- Any building (not apartments) containing a sleeping risk such as hotels, care homes etc. require fire and smoke dampers, however, if occupants can escape unaided and if there is an L1 detection system, may only require fire and smoke dampers on escape routes.

# To F&S Damper or Not to F&S Damper - Other considerations

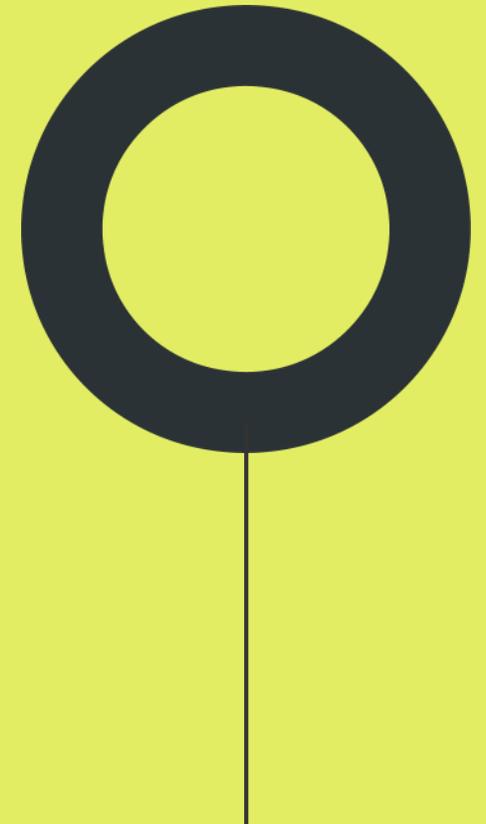
- Kitchen extract?

No fire dampers (fire rated ducts if the duct penetrates compartmentation).

- Smoke extract?

Be careful with design of smoke extract ductwork and smoke control dampers (no fusible link dampers permitted, may need to be powered closed, spring open).

# Basements.



# Smoke Ventilation of Basements.

- A basement is a storey that is more than 1200mm below the highest adjacent ground level.
- Basements may have a **major impact** on the fire safety provisions within building – due to the requirement to provide smoke ventilation.
- Basements greater than **3m in depth** or **greater than 200m<sup>2</sup>** require smoke ventilation.

# Smoke Ventilation of Basements.

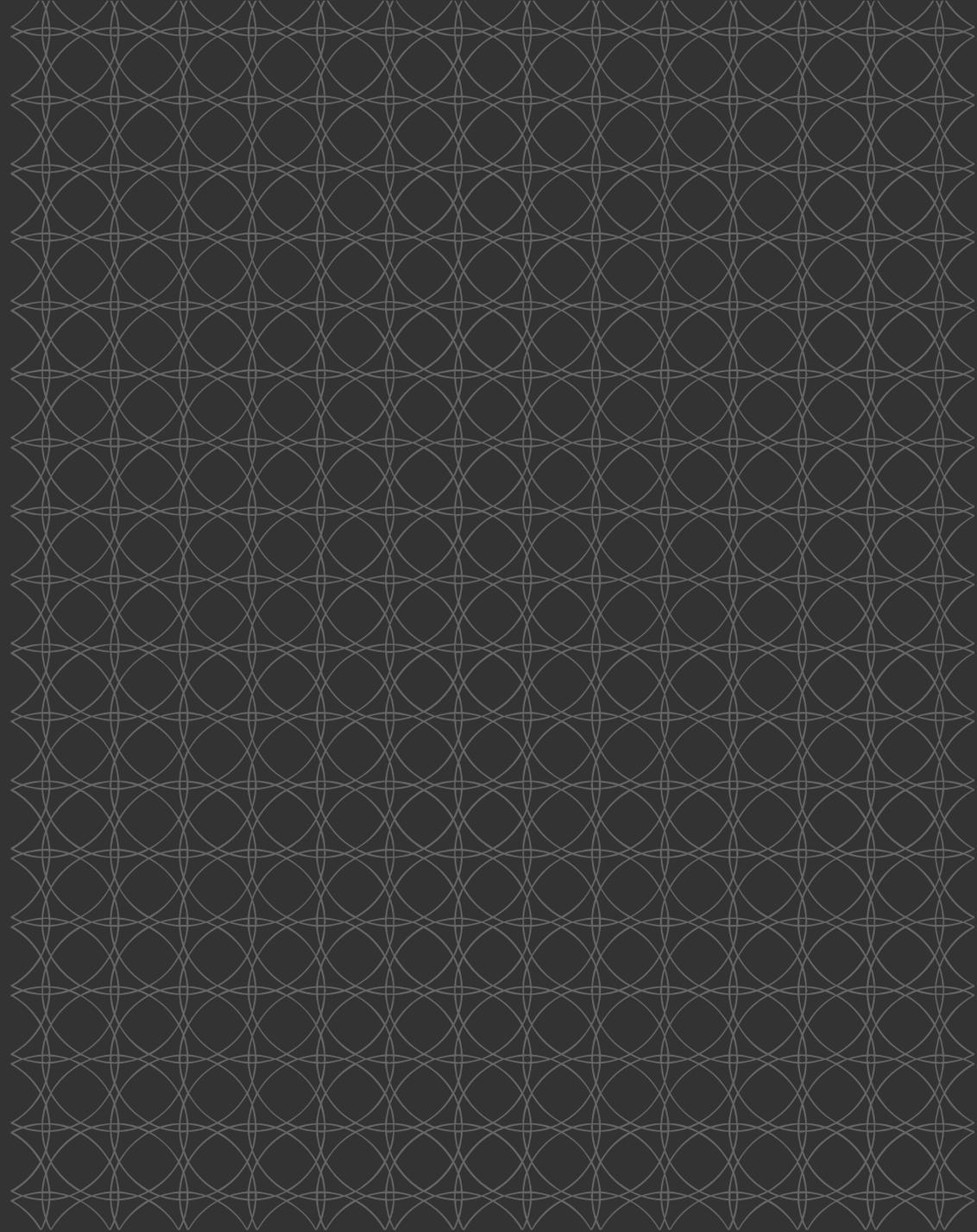
## Natural:

- High level smoke outlets.
- Evenly distributed.
- Combined clear cross-sectional area equal to  $1/40^{\text{th}}$  of the floor area.

## Mechanical:

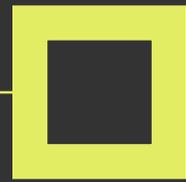
- Minimum of **10 ac/hr**.
- Capable of holding gas temperatures of up to **300°C** for a minimum of **1 hour**.
- Come into operation automatically on activation of AFD or sprinklers.
- If mechanical ventilation is provided to a basement (except a car park) **sprinklers MUST be provided**.

# Case Study.



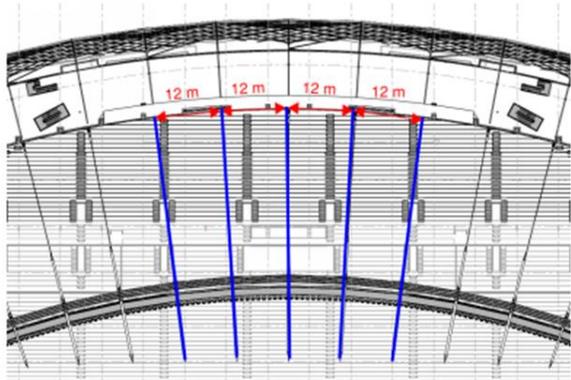


EDUCATION CITY STADIUM  
(2022 FIFA WORLD CUP)

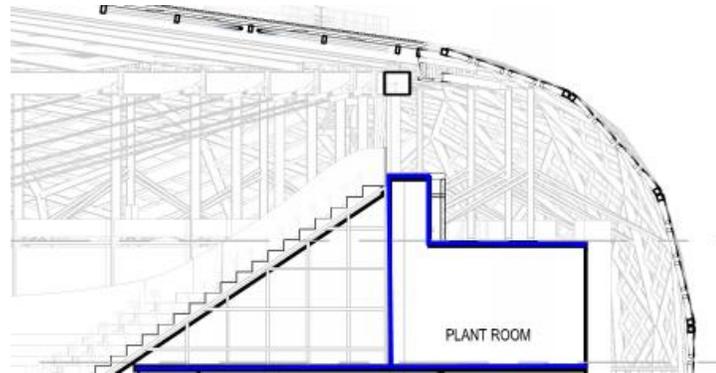


# Education City Stadium.

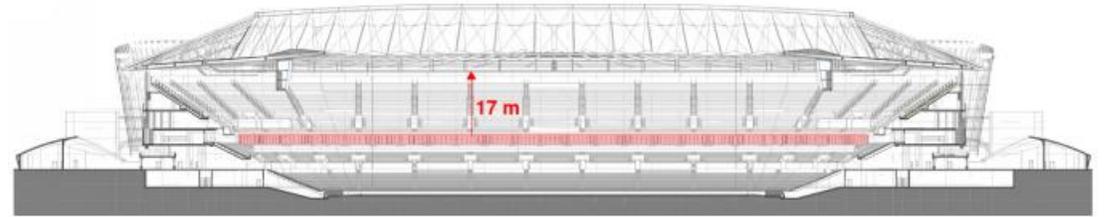
## Fire Engineered Solutions.



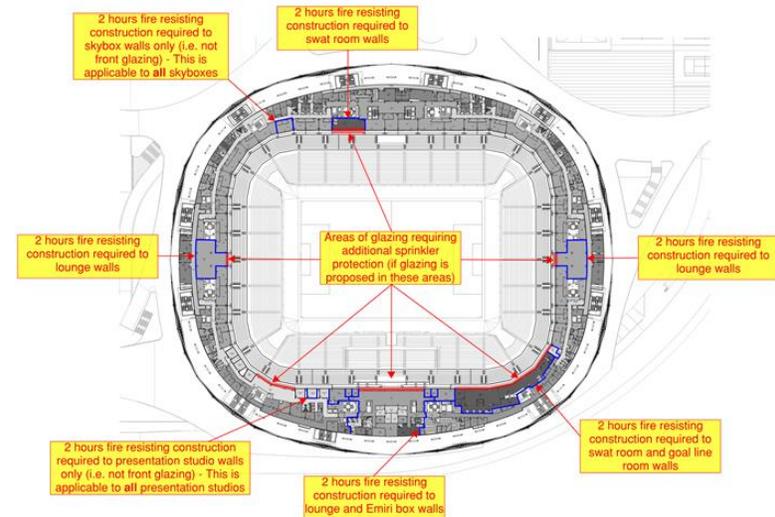
Omission of structural fire protection (roof)



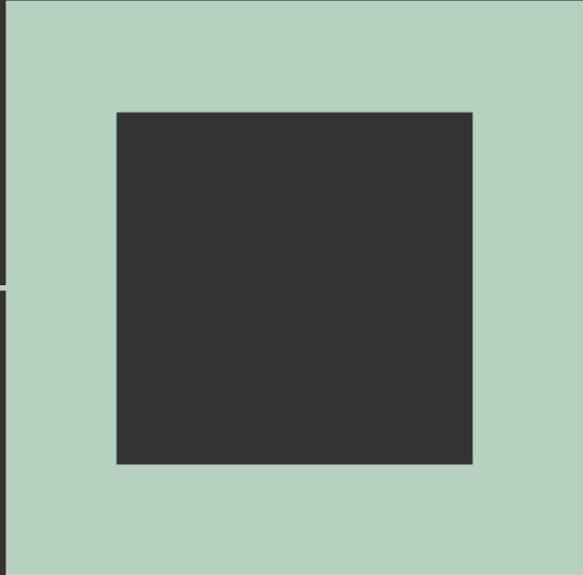
Omission of structural fire protection (seated tier)



Omission of bowl sprinklers



Omission of fire resistant glazing



**Thank you.**  
**[hoarelea.com](https://www.hoarelea.com)**