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Fire Engineering and the built environment

22nd March 2013

Presented by Matthew Ryan, Fire Engineer

Overview

- Introduction to London Fire Brigade (LFB) and Fire Engineering Group
- Applicable legislation and design options
- The building control process and LFB's role
- Engaging with fire engineering projects
- LFB's experiences from the unique perspective of a regulator

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London

- City and 32 Boroughs
- Area of >600 square miles
- Population of over 8 million people
- Historic, and at the forefront of modern building design
- Extensive transport systems
- At present, extremely large amount of construction
- Diverse
- Innovative
- Challenging for the fire service

Image source: www.londononline.co.uk

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LFB Fire Safety Regulation dept.

- Approximately 180 Inspecting Officers in Area Fire Safety Teams

- Several centrally located specialist groups
  - Transport Fire Safety Group
  - Petroleum Group
  - Fire Safety Policy Group
  - Enforcement Team
  - Fire Investigation
  - **Fire Engineering Group**

- Aim to influence and regulate the built environment, and reduce risk

- Vital role in Authority's overall strategy

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LFB Fire Engineering Group

- Small team of trained technical fire safety specialists
- Currently 9 posts (permanent and secondment)
- All hold or working towards formal fire safety engineering qualifications (BEng, MSc, CEng, IEng)
- Established 1990
- Primary role is to ensure quality control of fire engineering approvals process across London
- Buildings Regulations and Regulatory Reform (Fire Safety) Order 2005

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Brief history of modern era building control

- Up until mid- 1980s: prescriptive, rigid building design codes and approvals process: *Design to code – Build to code – Check to code*

- Frustration for designers/ consultants
- Need for flexibility
- Need for national economic growth
- Pressure on Government by businesses
- Door opened to fire engineering

- Bickerdike Allen report 1990 – public sector keeping pace with private sector

- Building, development of growth of world class cities

- Application of fire engineering has grown ever since

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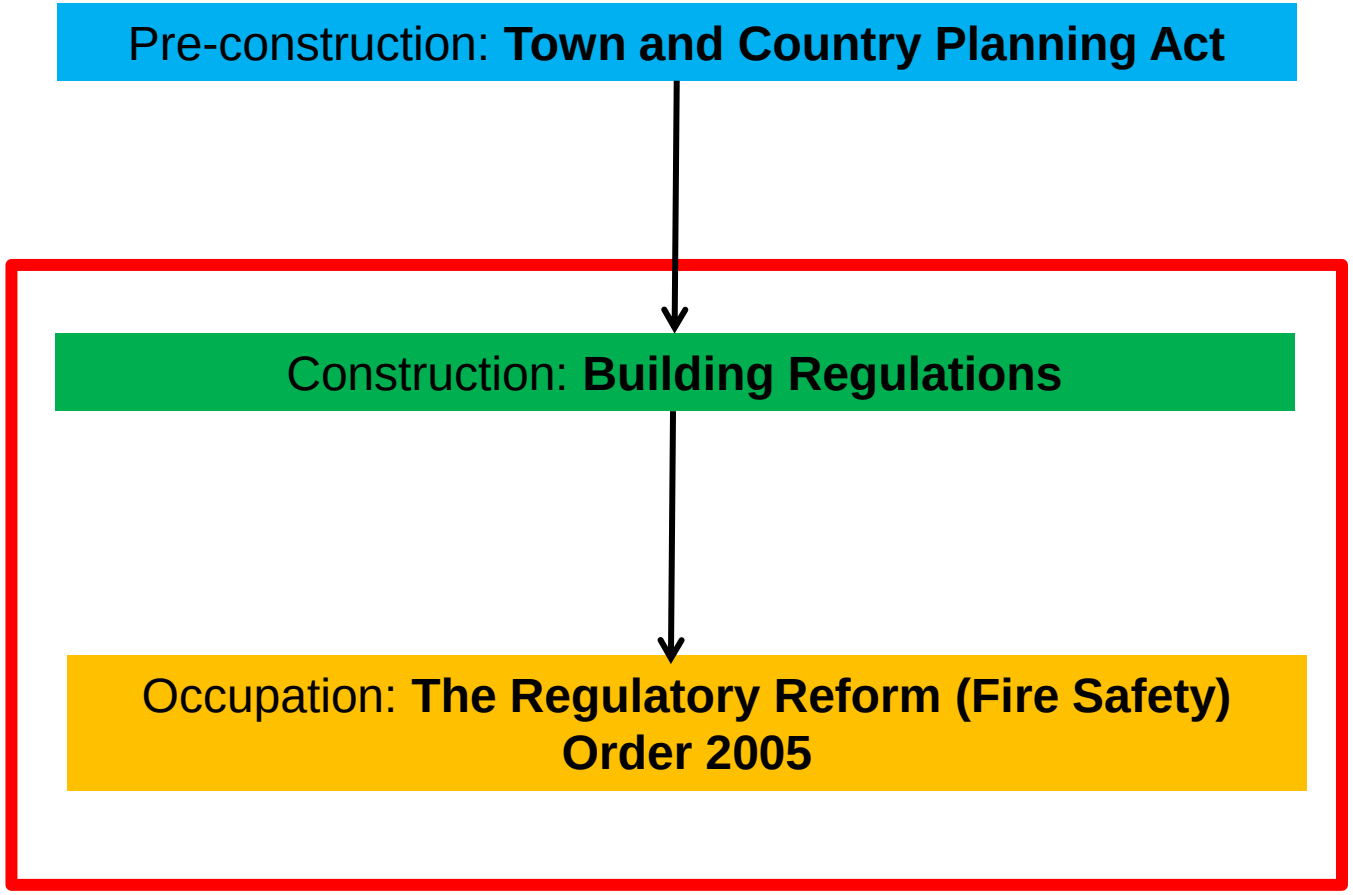
Primary legislation



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The Building Regulations

- Legislation that sets out the rules for building works so that buildings are safe, accessible, and efficient
- Reviewed by Government to keep up to date with construction practices, techniques and technology
- Many building design aspects covered
- Fire safety a key design consideration
- Based around **functional requirements**
- Supported by approved documents

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Fire safety requirements

- Primarily life safety driven

- Building designers must consider
  - Means of warning and escape
  - Internal fire spread (linings)
  - Internal fire spread (structure)
  - External fire spread
  - Access and facilities for the fire service

- Societally acceptable building standard to ensure occupant egress and fire service access.

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General fire safety principles

- **PREVENTION**
- **PROTECTION**
- **RESPONSE**

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Fire safety design approaches

- Prescriptive / 'off the shelf' approach

  e.g. Approved Document B

- Semi engineered / codified fire engineering

  e.g. British Standard 9999: 2008

- Fire engineered / performance based approach

  e.g. PD7974 series, CIBSE Guide E, SFPE

AIM: **MEET THE FUNCTIONAL REQUIREMENTS**

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Acceptance of fire engineering

- Approved Document B:

"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, e.g. airport terminals. Fire safety engineering may also be suitable for solving a problem with an aspect of the building design which otherwise follows the provisions in this document."

- Most common application in London: partial fire engineered buildings.

- Q: Will we ever see a FULLY fire engineered design proposal?

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Building control process (fire safety)

Source: www.ingeclemente.com

PROJECT APPROVAL

BUILDING CONTROL BODY
- Local authority
- Approved Inspector (private sector)

Source: http://cdn.lightgalleries.net

PROJECT DESIGN TEAM
- Developer
- Architect
- Project manager
- Construction team
- Specialist contractors
- Fire engineer

FIRE ENG. PROJECTS

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- Local Fire Safety Team
- Fire Engineering Group

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LFB position in the process

- Statutory consultee only; engaged with pre-consultation and at formal consultation.
- Building Regulations and RRO observations
- Building control body is the approver, not LFB
- LFB is impartial; public sector responsibilities
- LFB is not contracted/ paid by the developer
- LFB Fire Engineering Group are consultants for local LFB Fire Safety Teams

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Consultations with LFB

Ideally these should consist of:

- Formal building control body comments / observations
- Set of fire safety plans
- Fire strategy document
- Supporting specialist contractor documents (for example, smoke control system specification, CFD modelling, structural fire resistance analyses).

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The role of the fire strategy

- Crucial part of any fire engineered submission
- Ties all elements of the building's fire safety design approach together
- Main document reviewed during approvals process
- 'Building manual' for fire safety (Article 38 Building Regulations)
- Forms foundation of eventual building fire risk assessment on occupation

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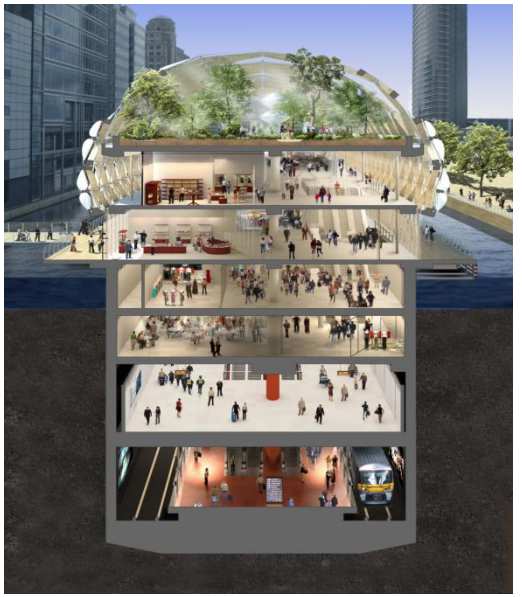
Example London projects



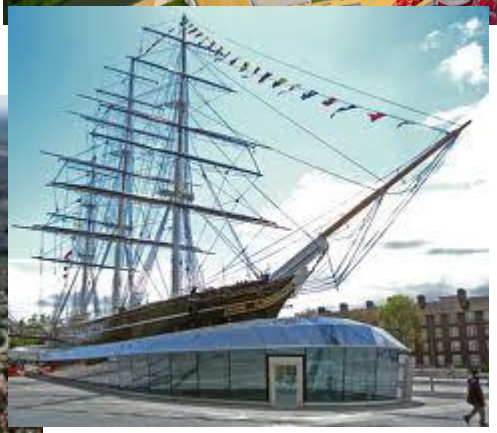


Image sources: The Shard - http://en.wikipedia.org/wiki/File:Shard_London_Bridge_May_2012.JPG; The Olympic Park - http://www.mirror.co.uk/sport/other-sports/athletics/what-time-is-the-olympics-2012-opening-1173826; Battersea Power Station - http://www.bbc.co.uk/news/uk-england-london-19491249; The Cutty Sark - http://www.hnsa.org/ships/cuttysark.htm;; Crossrail Canary Wharf - http://www.worldarchitecturenews.com/index.php?fuseaction=wanappln.showprojectbigimages&img=5&pro_id=13396

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Qualitative Design Review (QDR)

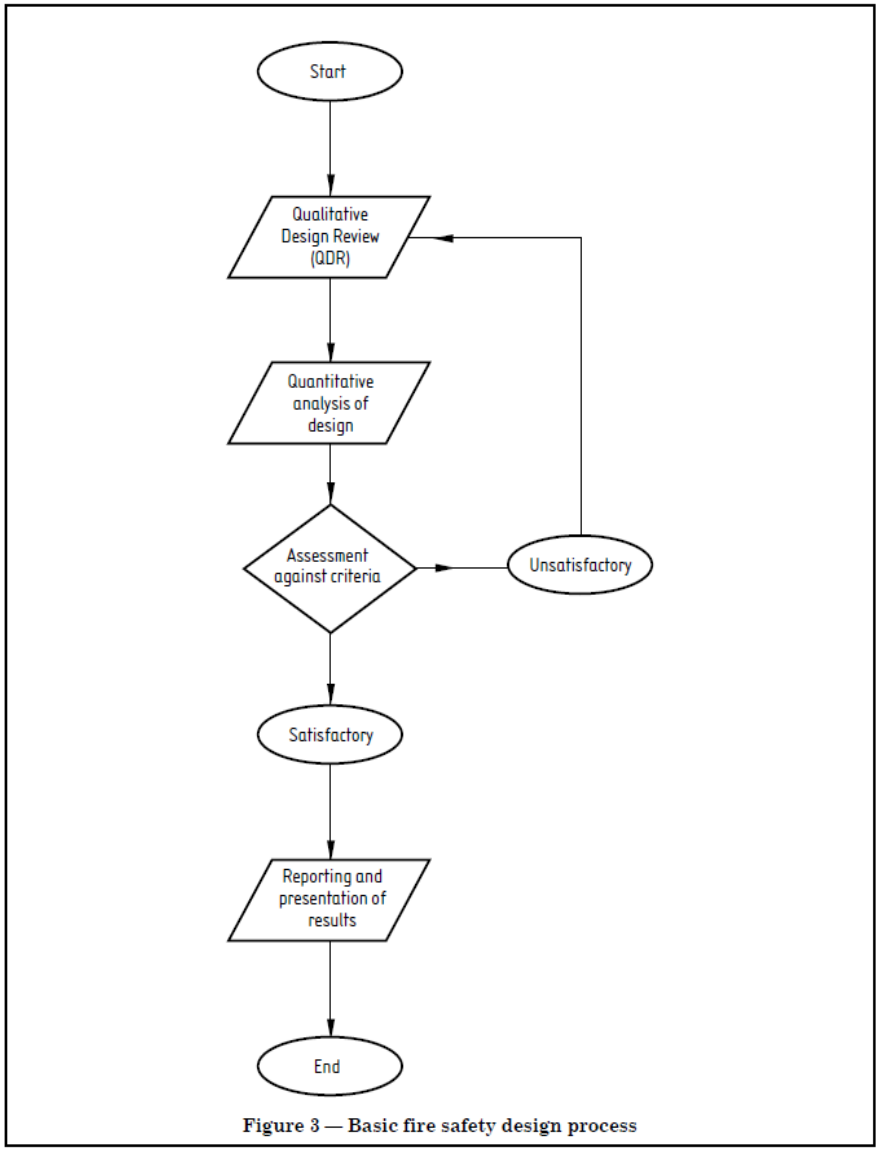

Figure 3 — Basic fire safety design process

- Project specific approach
- Key stakeholders
- Defines objectives and performance criteria
- Defines methods of assessment and evaluation
- Defines timescales
- Applied to small and large projects

Figure 3 from PD7974-0: 2002

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QDR considerations

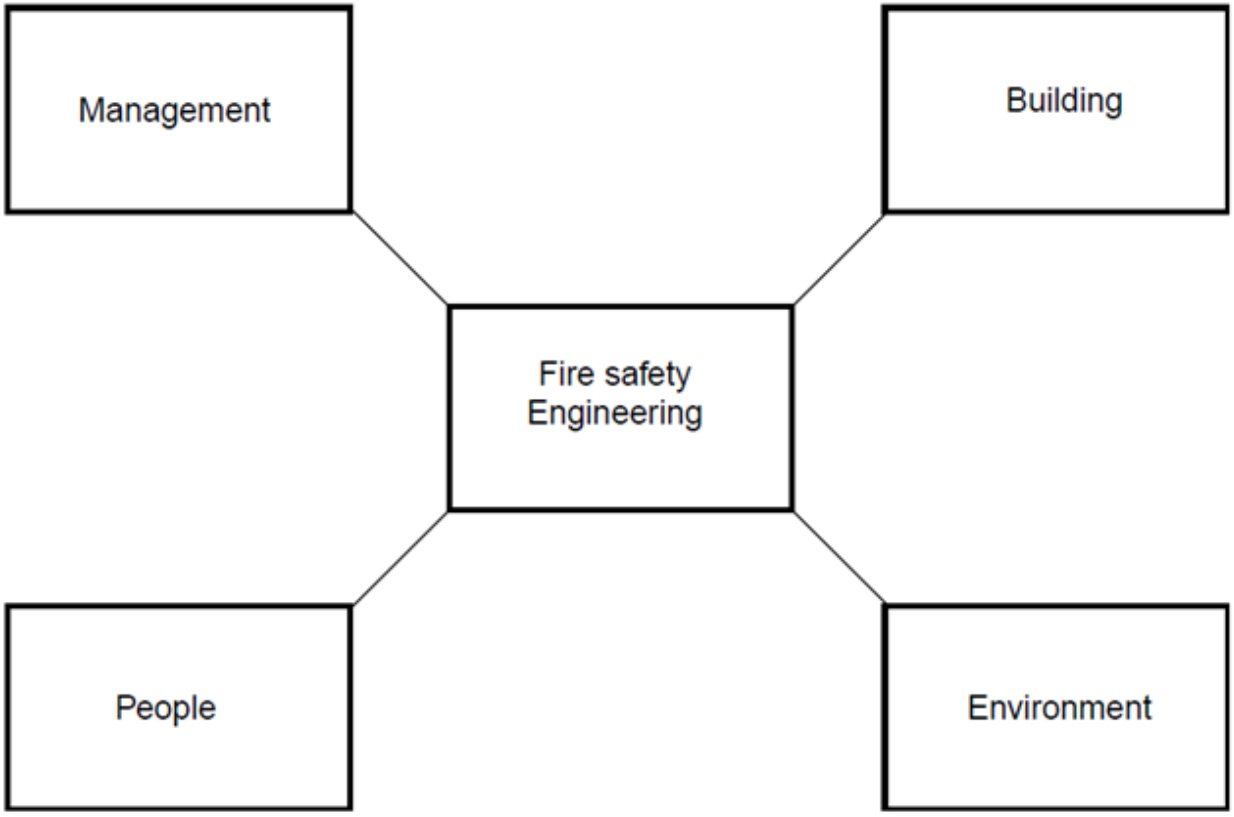

Figure 1 — Main factors involved in a fire safety engineering study

Figure 1 from PD7974-0: 2002

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BS7974 series

Application of fire safety engineering principles to the design of buildings — Code of practice
BS 7974
(Framework Document Philosophy)

Published Documents

(Handbooks providing supporting information and guidance)

PD 7974-0	PD 7974-1 (Sub-system 1)	PD 7974-2 (Sub-system 2)	PD 7974-3 (Sub-system 3)	PD 7974-4 (Sub-system 4)	PD 7974-5 (Sub-system 5)	PD 7974-6 (Sub-system 6)	PD 7974-7
Guide to design framework and fire safety engineering procedures	Initiation and development at fire within the enclosure of origin	Spread of smoke and toxic gases within and beyond the enclosure origin	Structural response and fire spread beyond the enclosure of origin	Detection of fire and activation of fire protection systems	Fire service intervention	Evacuation	Probabalistic risk assessment
Design approach QDR Comparison with criteria Reporting and presentation	Design approach Acceptance criteria Analysis Data References	Design approach Acceptance criteria Analysis Data References	Design approach Acceptance criteria Analysis Data References	Design approach Acceptance criteria Analysis Data References	Design approach Acceptance criteria Analysis Data References	Design approach Acceptance criteria Analysis Data References	Design approach Acceptance criteria Analysis Data References

Figure 2 — Structure of BS 7974:2001 and the Published Documents

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Need for early tri-partite meetings/ QDR

- Application of first principles fire dynamics
- Computational Fluid Dynamics (CFD)
- Other computer modelling (for example, evacuation modelling)
- Structural fire resistance analyses
- Complex evacuation strategies and means of escape calculations
- Smoke control
- Large site developments (multiple fire engineered buildings)
- Complex fire service access strategies

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Questions to consider

- Relevance of approach?
- Validity of approach?
- What if…?
- Sensitivity analyses? Safety margins?
- Can it be built?
- Is it practical? Can it be managed?
- **What do we know from real fires?**

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Communicating concerns / queries

- (QDR) Meetings with the project design team and building control body
- Recorded meetings minutes and tracker documents; audit trail of discussion and decisions
- Formal consultation letters to the building control body
- E-mails / telephone where appropriate
- All the above recorded on LFB Fire Engineering Group and local Fire Safety Team project files.

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Timescales

- 15 days consultation period under Building Regulations between building control body and fire service
- Fire engineered projects recognised as requiring longer to process
- Typical fire engineered project: 6months to 1year consultation
- Large / complex project: process can take years, with regular QDR meetings (for example, The Shard)

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Example: The Shard

- 310m tall tower: 72 habitable floors, +15 further floors, -3 basement levels
- Clad entirely with glass
- Tallest building in western Europe
- 'Vertical city'; multi occupancy including office, hotel, residential flats, restaurant uses and viewing galleries.
- Phased opening started 2013.
- LFB liaison on project began 2005.
- Regular QDR/ design team meetings from 2008
  - Monthly on average, periods of weekly

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Example: The Shard

- Fire engineering plays a central role to building strategy

  - x3 main stair cores (pressurised)
  - Large refuge areas
  - Phased evacuation
  - Mass evacuation lifts
  - Reduced structural fire resistance on certain floors (from 2hrs down to 90mins)
  - Sprinklers throughout
  - Mechanical smoke ventilation and natural smoke ventilation provisions
  - Wet rising main system / FF shafts
  - Fire command centre

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Post consultation issues

- Witnessing of commissioning tests for active fire safety systems (for example, smoke control systems).

- Fire safety audits of occupied building (i.e. ensuring theory has been put into practice).

- Gathering and sharing of (risk) information for fire fighters

Source: http://blog.coltinfo.co.uk/blog/bid/116735/When-is-smoke-control-needed-in-a-car-park

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Does the process work?

- In the majority of cases, yes

- Fire engineering has been readily accepted into the building control process

- If the process is managed correctly with stakeholder input, then robust alternative design solutions can be successfully applied based on sound engineering and scientific principles.

- **However**, some problems are emerging
  - Delayed consultations / *fait accompli* situations
  - Misunderstanding or lack of knowledge relating to fire engineering
  - Complacency
  - Built as designed? Theory into practice?
  - Enforcement action under Regulatory Reform (Fire Safety) Order 2005.

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Challenges for the future

- Increased use of fire engineering (and its link to value engineering)
- Legislation and policy changes; the de-regulation of the building control process
- Maintaining skills and competence (fire service and building control bodies)
- Local authority cost savings; economic recession
- Longevity of fire engineered strategies/ buildings?
- Fire fighter interactions with fire engineered buildings
- Analysis of real fire evidence that fire engineered buildings work

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Dziękuję

Thank you for listening

Contact: fireengineeringgroup@london-fire.gov.uk

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