Fire Protection Association

RISCAuthority

BDM01 – A to Z of Essential Principles for the protection of buildings

RISK INSIGHT, STRATEGY AND CONTROL AUTHORITY

REDUCING INSURABLE RISK THROUGH RESEARCH, ADVICE AND BEST PRACTICE

Version 3 Published 2023

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REVISION NOTES

The LPC *Design Guide for fire protection of buildings – A Code of Practice* for the Protection of Business was a joint publication by the Association of British Insurers (ABI) and the Fire Protection Association (FPA) in December 1999. It established general principles for the protection of property in the event of fire. The LPC Design Guide 1999 sought to assist in reducing financial loss by containing the fire as far as possible to one compartment of the building, with consideration given to control of fire spread by automatic sprinkler systems. It was printed as an A4 size paperback in 2000. Since publication, however, the general guidance had been overtaken by the demands presented in Modern Methods of Construction (MMC).

RISCAuthority published a series of Building Design Management (BDM) guidance documents to augment the general guidance of the LPC Design Guide 1999, starting with BDM01 *Fire protection of buildings – Essential principles* and followed by BDM02 *Fire protection of buildings – Core Document – Compartmentation*, first published in 2008. These documents continued to rely upon the LPC Design Guide 1999, and in particular Tables 2.1, 2.2 and 2.3, for compartment fire resistance and size with or without installation of an automatic sprinkler system.

The *LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance* further strengthened guidance for property protection from the LPC Design Guide. The LPC Sprinkler Rules include Technical Bulletin TB206:2020 Rev 1 *Passive fire protection of sprinklered buildings*, which replaces BS EN 12845:2015+A1:2019 clauses 5.1, 5.2 and 5.3. TB 206 Tables T1 and T2 provide the two insurer supported options for property protection.

https://www.thefpa.co.uk/shop/lpc-sprinkler-rules-with-bsen12845-book

This document as a revised and extended BDM01 *A to Z of Essential Principles for the protection of buildings* Version 3 – 2023 supersedes the archived BDM01 *Fire protection of buildings – Essential principles* Version 2 – 2015.

BDM01 *A to Z of Essential Principles* Version 3 – 2023 shall be read with the updated BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022, in book and poster form.

https://www.thefpa.co.uk/resource-download/405

https://www.thefpa.co.uk/resource-download/235

This document replaces the LPC Design Guide 1999. It orders the RISCAuthority essential principles alphabetically and maps them to the *RIBA Plan of Work 2020*.

https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work

IMPORTANT NOTICE

This document has been developed through RISCAuthority and published by the Fire Protection Association (FPA). RISCAuthority membership comprises a group of UK insurers that actively support a number of focused and expert Working Groups developing and promulgating best practice for the protection of people, property, business, and the environment from loss due to fire and other risks. The technical expertise for this document has been provided by the Technical Directorate of the FPA, external consultants, and experts from the insurance industry who together form the various RISCAuthority Working Groups.

Although produced with insurer input, this guidance does not (and is not intended to) represent a pan-insurer perspective. Individual insurance companies have their own requirements which may be different from or not reflected in the content of this document.

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1 How to use this document

This document describes the A to Z of Essential Principles determined by insurers for the protection of buildings, the businesses they support, and the services conducted from them. The principles are placed in six logical phases mapped to the widely used framework of the *RIBA Plan of Work 2020*, and all roles and responsibilities pertinent to developing and implementing resilience measures are assigned accordingly. The user may find it useful to navigate through the following:

- BDM01-4 Resilience Strategy by the initiating investor
- BDM01-5 Limitations in the legislative framework
- BDM01-6 Methodological thinking for BDM01 and BDM02
- BDM01-7 Ordering the Essential Principles with the *RIBA Plan of Work 2020*
- BDM01-8 Appointments to roles with responsibilities for resilience
- BDM01-9 A to Z Essential Principles checklist
- BDM01-10 A to Z Essential Principles supporting notes

A pathway is provided to assist the user to understand, satisfy, and support in the long term each of the Essential Principles.

The Essential Principles exist as:

- Letter
- Letter + Title
- Letter + Title + Description
- Letter + Title + Description + Checklist
- Letter + Title + Description + Checklist + Supporting Notes

BDM01 *A to Z of Essential Principles* Version 3 – 2023 is first in the Building Design and Management (BDM) series of RISCAuthority guidance documents on the design, construction and management of buildings. It shall be read with BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022 in book and poster form.

https://www.thefpa.co.uk/resource-download/405

https://www.thefpa.co.uk/resource-download/235

BDM01-14 Short glossary of terms and BDM01-15 Index of acronyms may be useful for the reader to browse, should the text be less than self-explanatory.

BDM01-16 contains an index of the Parts and Volumes of statutory guidance to Building Regulations in the devolved administrations, abbreviated to improve readability. Where older versions of statutory guidance are referred to, they are dated in the text. Future revisions of BDM01 will improve cross-referencing.

Verbs

The following verbal forms are used:

- "shall" indicates a requirement
- "should" indicates a recommendation
- "may" indicates a permission
- "can" indicates a possibility or a capability

2 Introduction

Legal provisions for fire protection are intended to assure a minimum level of health and life safety. This remit extends only to the point of successful evacuation of the building, and it is on this "evacuation-based" timescale that the performance of methods, products, and systems is tested as being fit for purpose.

Mundane threats of accidental fire that start in rooms are of course important, but prospects of arson, electrical faults, presence of flammable liquids, potential for explosions, and hazards in storage or processes related to occupancy may be significant. These too are to be kept in mind.

There may be an assumption that a greater level of protection is natively assured in a "compliant" building and that this extends to the protection of property, contents, and business. This is incorrect.

The protection of property and the continuity of activities it facilitates must be specifically requested by addressing the question of resilience. This requires an understanding of critical factors, and a determination of the role that intelligent building design and construction can play in ameliorating these risks. A building that complies with health and life safety regulation alone has little meaning to the building owner or operator, or their insurer, when considering susceptibility or vulnerability to, and the ability to recover from, adverse events.

A focus on health and life safety is of course vital, and a legal duty. However, it is insufficient for resilience in business, whether in the private, public or voluntary sectors.

RISCAuthority BDM01 *A to Z of Essential Principles for the protection of buildings* Version 3 – 2023 is an orderly recommendation to investors not to design and build down to the "life safety before collapse" objective but rather to define and insist upon the resilience their investment requires, beyond Building Regulations.

Resilience in the supply of product and services is a fundamental responsibility of every Managing Director as defined by the Institute of Directors. Failure of a business to anticipate reasonably foreseeable adverse impacts, such as fire or water damage, demonstrates a failure of professional management.

As a department within the Fire Protection Association (FPA), RISCAuthority is supported by a significant group of insurance companies through a series of expert Working Groups, furthering best practice for the protection of property and business from insured perils.

The FPA website includes an "Index of Resources" link on the upper navigation bar, which opens a page providing direct access to all FPA resources. Items marked as "Member Only" are accessible by members.

https://www.thefpa.co.uk/index-of-resources

BDM01 *A to Z of Essential Principles* Version 3 – 2023 addresses the major perils of fire and water events that are known to cause significant financial loss from material damage and associated business interruption.

Although best implemented at the time of design, the same principles may be applied retrospectively to existing buildings, particularly at times of alteration and refurbishment. These principles always depend on facilities management.

3 Objective

The objective of BDM01 *A to Z of Essential Principles* Version 3 – 2023 is to identify and order aspects of building design and construction that can be strengthened to protect property and business against damage from fire and water related events. BDM01 *A to Z of Essential Principles* 2023:

- aims to provide an armature for memory, discussion and learning about the decision-making process of building development and management that is valued by business and the insurance market.
- introduces the initiating investor in buildings to their selected insurer.
- identifies roles and responsibilities and apportions them within the *RIBA Plan of Work 2020* framework, in which project decision making is conducted through intermediaries, coordinated in a division of labour that becomes extended by the complexity, scale and pace of the endeavour.
- appreciates, but does not dwell upon, matters of health and life safety that are addressed by the law of the Building Regulations, which shall result in an Evacuation Strategy as part of a Fire Strategy.
- works to an understandable framework of avoiding susceptibility, reducing vulnerability, and improving recoverability, which together identify additional measures investors and their insurers may value in a Resilience Strategy.
- seeks to ensure that the resulting building is "insurable", which is an emerging challenge for some Modern Methods of Construction (MMC).

Consequently, BDM01 includes both explicit and implicit criticism of where the Building Regulations, and the statutory guidance that articulate the law, fall short in their promise to address health and life safety. BDM01 2023 also suggests more is required than the "life safety before collapse" objective of legislation.

There is an understanding in construction that defects are "latent" until they become "patent". Clairvoyance is not expected of the professional, but reasonable foresight is. Anticipation is an imaginative talent among designers. When trying to plan ahead it helps to make the effort to learn from the experience of others. To appreciate construction history, not only as a thing of the past, but as something made new, in the present. The insurance sector actively works to understand risks to enable competitive pricing of premiums. The principle of insurance is that the losses of the few are paid for by the premiums of the many.

A future objective of BDM01, and perhaps a "spin off" title in the BDM series that can be referred to, will be to digest the valuable work of Collaborative Reporting for Safer Structures (CROSS). This body of work dates back to 1976 and the Standing Committee on Structural Safety (SCOSS), established in the UK by the Institution of Structural Engineers (IStructE), the Institution of Civil Engineers (ICE), and the Institution of Municipal Engineers (IMunE). The IMunE merged with the ICE in 1984. This document will increasingly refer to CROSS Safety Reports.

https://www.cross-safety.org/uk/about-cross/our-history

BDM01 Keynote

RISCAuthority BDM01 *A to Z of Essential Principles for the protection of buildings* is an orderly recommendation to investors, on behalf of insurers, not to design and build solely down to the "life safety before collapse" objective on the assumption that the project is a "common building situation". Instead, to define and insist upon the resilience their investment requires, beyond statutory guidance or Building Regulations. It calls for resilient construction innovation to improve health and life safety with measures anticipating likely events involving fire and water.

4 Resilience Strategy by the initiating investor

Resilience is a discrete discipline that seeks to ensure the continuity of service that a property provides, and of the business conducted within it or the service provided from it. While there can be commonality with many Risk Control (RC) measures, resilience considerations and solutions can have a much greater reach and be assured through a Resilience Strategy.

During the design phase every opportunity should be taken to create a resilient building that will support the continuity of activities conducted within it, and improve recoverability of those activities following a damaging event.

Resilience may be broken down into the three phases of:

Susceptibility

Avoiding fire and water related perils being an issue. For example, by avoiding sites and building forms that are susceptible to flooding, by building with materials that are not ignitable, cannot support combustion, and are unaffected by water, or by reducing dependency on human actions and interventions.

Vulnerability

Reducing the extent of damage following a fire or water related event by building in measures. For example, by locating critical systems above the maximum flood level, by providing compartmentation and sprinkler protection, waterproofing, and safe-passage water drainage systems, and/or by installation of detection systems.

Recoverability

Improving the rapid recovery to full capability following fire and water related events. For example, by consultation with insurers and the Fire and Rescue Service, through training in fire safety or escape of water incidents, and through business continuity planning that involves facilities management.

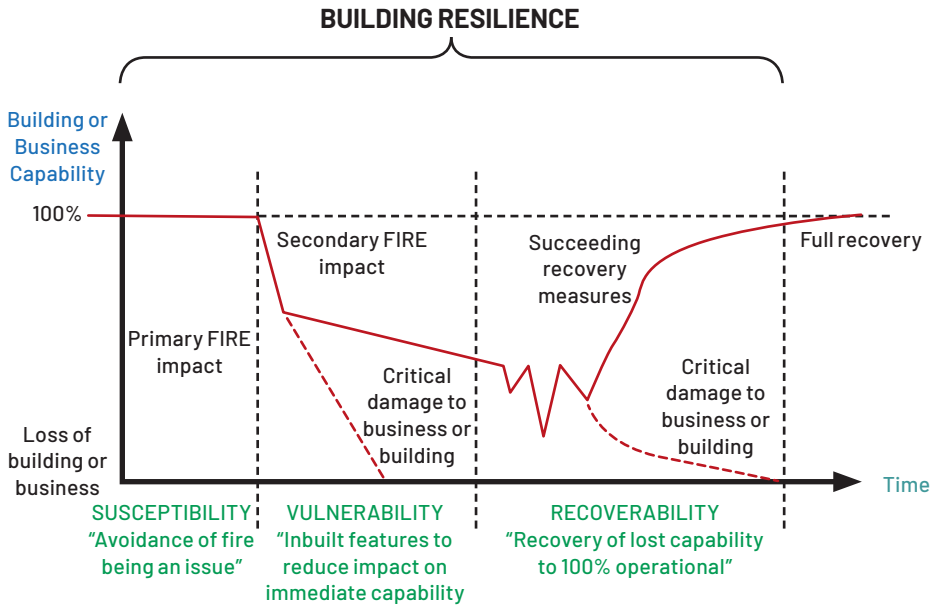

Figure BDM01-4.0.1 Phases of Resilience – RISCAuthority

Strategic efforts for avoiding susceptibility, reducing vulnerability, and improving recoverability are further discussed as Principle A in the BDM01-9.1 checklist and in the associated BDM01-10.1 supporting notes. Thinking about these phases helps to identify additional measures investors and their insurers may value or require in a Resilience Strategy, informing the work of following consultants and contractors.

The greatest challenges are around avoiding susceptibility of materials to ignition and burning, and to water damage. Without the ability to select higher performing materials, the options for resilience become limited to the deployment of measures for reducing vulnerability and improving recoverability once an event takes place.

Attempts to achieve resilience through facilities management processes should not ignore the importance of developing a Resilience Strategy to provide a more optimal approach for the investor and their insurer.

The susceptibilities, vulnerabilities, and recoverabilities of a business are determined through the construction of a Business Continuity Plan (BCP) during the Business Impact Assessment (BIA) process. These shall inform the Resilience Strategy document provided as a brief to design consultants.

The investor's Resilience Strategy is the business and insurance driven brief for new building work, concerned with limiting fire and water damage. The investor's Resilience Strategy stands alongside the architectural requirement to reconcile form and function in a planning application, and the legal requirement for health and life safety. These three briefings must result in the objective of fire safety:

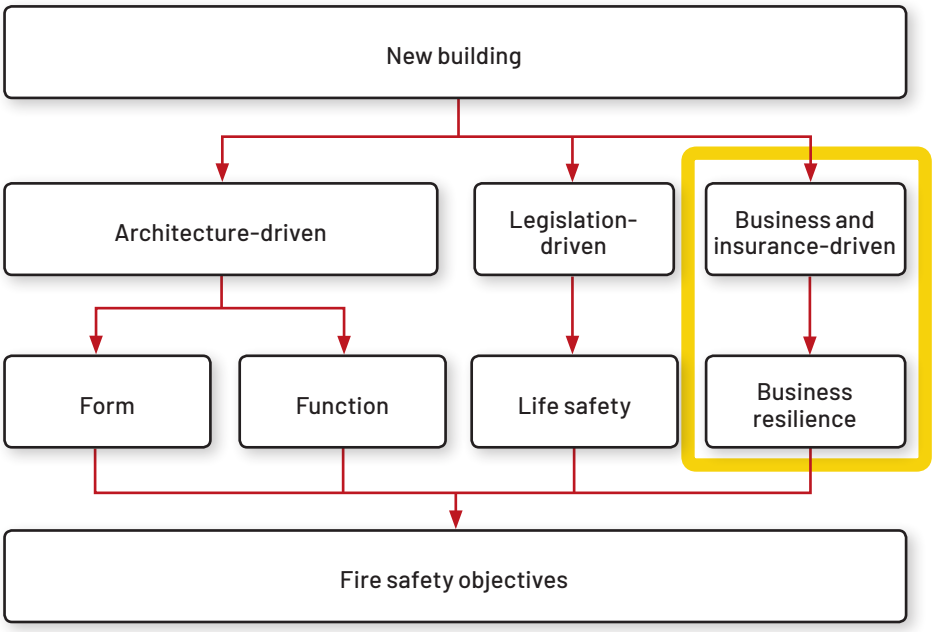

Figure BDM01-4.0.2 Drivers and Objectives in Fire Safety – RISCAuthority

It may be argued that fire safety is an architectural function, or that the architect thinks about ways to limit fire and water damage. However, Principle A argues for a Resilience Strategy from the investor, as the investor's brief to the consultants and contractors who will be engaged in the building works, and not only to the architect. Some work does not involve an architect, even when a planning application is made, but all works require a measure of resilience as Principle A.

5 Limitations in the legislative framework

5.1 Building Act 1984 and subsequent devolution

The power to make Building Regulations is given for a legal purpose.

In England, that power is exercised by the Secretary of State of the responsible Ministry, currently the Department for Levelling Up, Housing and Communities (DLUHC), as established in Section 1 of the Building Act 1984.

https://www.legislation.gov.uk/ukpga/1984/55/section/1

In Section 1(1) of the Building Act 1984, the power to make Building Regulations in England is extended through the Secretary of State for the purpose of:

(a) securing the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings

Other purposes are authorised beyond Section 1(1)(a) health and life safety of the Building Act 1984, which this document further addresses in BDM01-10 supporting notes. For example, for water there is a Section 1(1) purpose of:

(c) preventing waste, undue consumption, misuse or contamination of water

Section 1(1)(c) provides a wider purpose for water. Otherwise there is no attempt to argue that fire and water damage hazards may be addressed through legislated purposes beyond the health and life safety concern of Section 1(1)(a). Section 1 of the Building Act 1984 does not explicitly admit property protection or resilience more widely as legal purposes for making Building Regulations.

The Building Act 1984 instructs legislation in national Building Regulations to ensure a reasonable standard of health and life safety is provided in the event of fire. Other legislation has followed with devolution since 1984.

Since devolution in Scotland, there is a similar power to make building regulations in Crossheading 1 of the Building (Scotland) Act 2003.

https://www.legislation.gov.uk/asp/2003/8/part/1/crossheading/power-to-make-building-regulations

The Building (Scotland) Act 2003 extends a shorter list of purposes:

(a) securing the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings,

(b) furthering the conservation of fuel and power, and

(c) furthering the achievement of sustainable development,

The Scottish purposes are directly comparable to purposes in England. The first purpose is health and life safety. In Wales it is the same. Since devolution in Wales the power to make Building Regulations in Section 1(1) of the Building Act 1984 was transferred in the Welsh Ministers (Transfer of Functions) (No. 2) Order 2009.

https://www.legislation.gov.uk/uksi/2009/3019/contents

The Building Regulations (Northern Ireland) Order 1979 is the primary legislation for Building Regulations in Northern Ireland, amended by the Planning and Building Regulations (Amendment) (NI) Order 1990 and the Building Regulations (Amendment) Act (Northern Ireland) 2009. Article 3 of the Building Regulations (Northern Ireland) Order 1979 provides the power to make Building Regulations to the Department of Finance in Northern Ireland, who can determine the purpose.

https://www.legislation.gov.uk/nisi/1979/1709/article/3

https://www.legislation.gov.uk/nisi/1990/1510/contents

https://www.legislation.gov.uk/nia/2009/4/section/1

For England and Wales it is the Building Regulations 2010, for Scotland it is the Building (Scotland) Regulations 2004, and for Northern Ireland it is the Building Regulations (Northern Ireland) 2012 that apply:

- England and Wales – Building Regulations 2010
  https://www.legislation.gov.uk/uksi/2010/2214/contents
- Scotland – Building (Scotland) Regulations 2004
  https://www.legislation.gov.uk/ssi/2004/406/contents
- Northern Ireland – Building Regulations (Northern Ireland) 2012
  https://www.legislation.gov.uk/nisr/2012/192/contents

However, there has been some divergence between the English and Welsh versions of the Schedule 1 Requirements of the Building Regulations 2010. The English version is collated for reference as BDM01-11.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/1

Subsequent revisions of BDM01, perhaps through extension of the BDM series, will address the various Regulations and scheduled Requirements in Scottish, Welsh, and Northern Irish Building Regulations directly. BDM01 Version 3 – 2023, however, is limited to those in England in the effort to establish principles.

The Essential Principles will apply across the divergent Regulations and scheduled Requirements of devolved administrations and, as amendments are being made to them, there is reason to think that some technical convergence is occurring. It is noticeable that England is following Scotland on some aspects of fire safety. The regulatory thinking between the devolved administrations is changing.

Greater attention is being given to the investigation and reporting of incidents, the sharing of lessons learned between the English Fire and Rescue Services, and the publication of this significant effort. In November 2022, *An in-depth review of fire-related fatalities and severe casualties in England, 2010/11 to 2018/19* was published by the Home Office. This Home Office review of available data is discussed as BDM01-10.3, in the supporting notes for Principle C.

https://www.gov.uk/government/publications/an-in-depth-review-of-fire-related-fatalities-and-severe-casualties-in-england-2010-to-201819/an-in-depth-review-of-fire-related-fatalities-and-severe-casualties-in-england-201011-to-201819

There is scant publicly available examination of whether the legislative framework since 1984 is successfully "… securing the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings."

5.2 Building Regulations 2010 as amended 2018 and 2022

The Building (Amendment) Regulations 2018 and the Building etc. (Amendment) (England) Regulations 2022 were enacted as legislation in England in response to the Grenfell Tower fire on 14 June 2017, which killed 72 and injured more.

https://www.legislation.gov.uk/uksi/2018/1230/contents/made

https://www.legislation.gov.uk/uksi/2022/603/contents/made

Further change is anticipated as Sir Martin Moore-Bick, the chairman of the Grenfell Tower Inquiry, comes to his conclusions in 2023. His findings and criticisms will profoundly affect the construction industry, leading to policy recommendations, and influencing the level of public support for them. This will perhaps have a differentiated impact on the regulatory thinking of the devolved administrations.

Discussed further as BDM01-12, these important amendments to the law of Regulation 7 of the Building Regulations 2010 prescribe the non-combustibility of specific component parts of the external wall. The Building Regulations 2010 amended in regulation 2(6)(c) by the Building etc. (Amendment) (England) Regulations 2022 further prohibits the use of "relevant metal composite materials" in the external walls of all buildings of any height.

This is a technical threshold for Metal Composite Materials (MCM) above a gross calorific value of more than 35 MJ/kg when tested in accordance with BS EN ISO 1716:2018 *Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value).* MCM includes a range of Aluminium Composite Materials (ACM). An ACM with a gross calorific value of around 45 MJ/kg was used in the refurbishment of Grenfell Tower. This is further discussed in BDM01-10.4 supporting notes for Principle D, with test equipment illustrated in BDM01-13.2.

The technical threshold of the MCM prohibition in law has been set at 35 MJ/kg because setting a lower gross calorific value threshold would question the wider market for combustible claddings, which include timber at above 15 MJ/kg. This is entirely a policy decision, because non-combustible materials allowing minimal smoke but no melting droplets have a gross calorific value of 3 MJ/kg or less.

There is no universal prohibition on combustible materials in the external wall. The limitation on "relevant metal composite materials" allows combustible MCM with a gross calorific value of less than 35 MJ/kg, while no legally binding technical threshold is set on other cladding products within the external wall. Principle D continues to be highly relevant for most construction.

Similar amendments for MCM cladding of >35 MJ/kg were being made in the other devolved administrations at the time of publication, all with the same policy towards the wider market for combustible cladding. Furthermore, neither the 2018 nor the 2022 amendments to the 2010 iteration of Regulation 7 addressed fire resistance in addition to combustibility, or the wider quantitative and qualitative questions of smoke.

Other changes are being made through statutory guidance, significantly in current thinking about evacuation through the means of escape. The power to author statutory guidance was granted to the Secretary of State of the responsible Ministry, currently DLUHC, in Section 6 of the Building Act 1984.

https://www.legislation.gov.uk/ukpga/1984/55/section/6

The national Building Regulations in the devolved administrations are then articulated in statutory guidance as a non-mandatory but practical way of complying with the legal requirements for common building situations.

The statutory guidance for the devolved administrations is available here, and indexed as BDM01-16:

- England – Approved Documents
  https://www.gov.uk/government/collections/approved-documents
- Scotland – Technical Handbooks
  https://www.gov.scot/policies/building-standards/monitoring-improving-building-regulations/
- Wales – Approved Documents
  https://gov.wales/building-regulations-approved-documents

- Northern Ireland – Technical Booklets
  https://www.finance-ni.gov.uk/articles/building-regulations-technical-booklets

BDM01 and BDM02 refer only to Table 0.1 Classification of Purpose Groups in both Volumes of the English statutory guidance of:

- **(E-AD-B)** *Approved Document B: Fire safety*
  https://www.gov.uk/government/publications/fire-safety-approved-document-b

  (E-AD-Bv1) Volume 1 – *Dwellings* (2019 as amended 2020 and 2022)

  (E-AD-Bv2) Volume 2 – *Buildings other than dwellings* (2019 as amended 2020 and 2022)

Within this document these current Parts of English Approved Documents will be referred to as BDM01-16 (E-AD-B), or differentiated by Volume as (E-AD-Bv1) and (E-AD-Bv2). Similarly, all other Parts of statutory guidance referred to will be abbreviated as BDM01-16, while older versions shown with dates in the text.

The objective of relating English Purpose Groups to the differentiated Scottish, Welsh and Northern Irish treatments will follow in future revisions of BDM01 and BDM02. With BDM01 established with revision control, that task should become simpler as the devolved administrations update their statutory guidance, and further change the law of their respective Building Regulations.

Regulation 8 of the Building Regulations 2010 follows Section 1 of the Building Act 1984 in limiting the purpose of legislation.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/8

Schedule 1 Requirements, shown as amended as BDM01-11, are explicitly limited by Regulation 8 of the Building Regulations 2010. Schedule 1 Part B Fire safety and Part G Sanitation, hot water safety and water efficiency are only about health and life safety, with the exception of Requirements G2 and G2A which follow Section 1(1)(c) of the Building Act 1984.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/1

Regulation 38 Fire Safety Information exchange is only about health and life safety, as important as that is. Fire safety information valued by investors and insurers has to start in a Resilience Strategy as BDM01-4. This is further discussed as Principle S in BDM01-10.19 and Principle V in BDM01-10.22.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/38

The objective of the law is to protect health and life safety, most obviously by means of escape. Once a building is evacuated, the Fire and Rescue Service are not expected to put themselves at further risk.

After successful evacuation, there is no expectation placed on how the building should perform, or even how the fire event should ultimately be brought to an end. Even the total loss of the building and all of its contents can be accepted as a successful outcome, provided mechanical construction failure through to structural collapse does not represent a threat to the health and life safety of occupants or firefighters in the vicinity, and within any surrounding buildings.

While this may not be a measure of success to an investor, the political policy is that those with financial interests in property are free at any time in the life of a building to implement measures that exceed the health and life safety purpose of the Building Regulations. Then, once invested, to pay for cover in the insurance market based on the hazard, risk and potential loss profile.

There is no indication from government that the legal position on the purpose of Building Regulations will change in the near future in favour of protecting any interest in property.

5.3 Building Safety Act 2022 and new liabilities

The Building Safety Act 2022 has not changed the health and life safety limitation in the Building Act 1984 and the Building Regulations 2010 for events that result in fire and water damage to property.

https://www.legislation.gov.uk/ukpga/2022/30/contents/enacted

The commitment to health and life safety has been strengthened by activation of Section 38 Civil liability in the Building Act 1984, through Section 130 Building liability orders of the Building Safety Act 2022.

Section 130 of the Building Safety Act 2022 gives power to the High Court to make a Building Liability Order (BLO) against a corporate body for a "relevant liability", either under the Defective Premises Act 1972 retroactively extended for 30 years, or through Section 38 of the Building Act 1984, or as a result of a building safety risk being established. That is defined as "... a risk to the safety of people in or about the building arising from the spread of fire or structural failure."

https://www.legislation.gov.uk/ukpga/2022/30/section/130/enacted

This may prove to be powerful legislation. The definition of defects under the Defective Premises Act 1972, when health and life safety has been the explicit purpose of Building Regulations, will exercise lawyers for some time.

Section 38 Civil liability is for a breach of a duty imposed by Building Regulations so far as it causes "damage", where "... damage includes the death of, or injury to, any person (including any disease and any impairment of a person's physical or mental condition)." Despite a wide scope of personal damage, as important as that will undoubtedly prove to be, there is nothing about damage to property.

https://www.legislation.gov.uk/ukpga/1984/55/section/38

Civil liability had not previously been generally activated through Section 134 Commencement of the Building Act 1984, even though the Secretary of State had been delegated the power to activate Section 38. It is unclear why Section 38 Civil liability had not been commenced by any Secretary of State before the Building Safety Act 2022, since the Building Act 1984 gave them the power to do so.

https://www.legislation.gov.uk/ukpga/1984/55/section/134

None of this legislation appears to change the health and life safety purpose of Building Regulations in Section 1 of the Building Act 1984 for fire and water damage. This means the "life safety before collapse" objective of building legislation is intact as a default in the construction industry.

5.4 Manual to the Building Regulations and building control

The *Manual to the Building Regulations – A Code of Practice for use in England* – July 2020 reiterates that neither compliance with statutory guidance nor building control approval are any guarantee of compliance with the law of the Building Regulations 2010. Themselves with a limited purpose of health and life safety.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/901517/Manual_to_building_regs_-_July_2020.pdf

Following BDM01-16 (E-AD-B) as statutory guidance to the Building Regulations 2010 in England may be insufficient to provide for health and life safety, if the project is not a "common building situation".

The Manual cautions the English Approved Documents may provide inappropriate guidance if the case is uncommon in design, setting, use, scale, or technology. The uncommon cases may include, but are not limited to, any of the following:

a. difficult ground conditions

b. buildings with unusual occupancies or high levels of complexity

c. very large or very tall buildings

d. large timber buildings

e. some buildings that incorporate modern construction methods

Government is promoting Modern Methods of Construction (MMC) but is also cautious of the technical differences that are emerging. There is no coherent technical guidance on MMC that explains how the construction industry achieves health and life safety, other purposes of Building Regulations, or wider resilience.

There is considerable but often inconclusive academic study, and a proliferation of competing trade associations promoting their sector as leaders in MMC, even while caution is being raised among agencies with regulatory overview. The National Fire Chiefs Council (NFCC) published a *Modern Methods of Construction Policy Position Statement* on 6 December 2022, dated November 2022, for example.

https://www.nationalfirechiefs.org.uk/news/nfcc-publishes-modern-methods-of-construction-position-statement/278529

https://www.nationalfirechiefs.org.uk/write/MediaUploads/Position%20statements/Protection/NFCC_MMC_Policy_Position_Statement__Final.pdf

This predicament is discussed in BDM01-10.1, but it complicates reading of the statutory guidance. Not all MMC is an "uncommon building situation".

On 23 August 2022, DLUHC significantly published *Approved Document B: Fire safety – frequently asked questions*, providing answers to some Frequently Asked Questions (FAQs) on BDM01-16 (E-AD-B) (2019 as amended 2020 and 2022).

https://www.gov.uk/guidance/approved-document-b-fire-safety-frequently-asked-questions

Under the sub-heading "The application and scope of Approved Document B", two cautions were provided, with FAQ 17 relating explicitly to timber primary structures and FAQ 18 referring to alternatives with an "unusual structural design approach", which included "volumetric modular construction" as an example of MMC:

- FAQ 17 – Buildings with combustible structure
- FAQ 18 – Buildings with alternative structural failure mechanisms

The FAQs of 23 August 2022 do not address the distinction between "common" and "uncommon" that must exercise the Ministry as authors of the Approved Documents as much as those referring to such statutory guidance. On the same day, DLUHC published a Circular Letter dated 22 August 2022 on the controversial subject of *Single stair provisions in very tall residential buildings and applicability of the Approved Documents*.

https://www.gov.uk/government/publications/single-stair-provisions-in-very-tall-residential-buildings-and-applicability-of-the-approved-documents-circular-letter

This Circular Letter on single stairs was accompanied by a letter from the Building Regulations Advisory Committee (BRAC) in England, dated 25 March 2022.

BRAC was established to advise on the first National Building Regulations in 1965, and re-established on the continued basis of Ministerial appointment without public record under Section 14 of the Building Act 1984. There has been a separate Building Regulations Advisory Committee for Wales (BRACW) since 2009.

https://www.legislation.gov.uk/ukpga/1984/55/section/14

BRAC addressed the means of escape provisions for Higher Risk Buildings (HRBs) and both Volumes of Approved Document B as BDM01-16 (E-AD-B):

"In particular we are concerned that (HRBs) might be designed on the incorrect premise that the guidance in the ADs is adequate for all tall buildings and offers a 'deemed to satisfy' approach."

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1099099/BRAC_letter_about_stairs_to_Lord_Greenhalgh.pdf

Based on BRAC concerns about means of escape, the Circular Letter on single stairs referred back to a series of ongoing technical reviews at the Ministry:

1. Specialised housing and care homes
2. Means of escape for disabled people
3. Balconies, spandrels and glazing
4. Structural fire resistance and fire separating elements
5. Trigger heights and thresholds
6. Smoke and toxicity
7. Construction technologies and design
8. Classification of external wall construction review
9. Means of escape in blocks of flats
10. Property protection

https://www.gov.uk/government/consultations/technical-review-of-approved-document-b-of-the-building-regulations-a-call-for-evidence/outcome/technical-review-of-approved-document-b-2022-progress-update

BDM01 Version 3 addresses these themes, but further revision of BDM01 will be required when the ongoing technical reviews are published and their conclusions manifested in amended statutory guidance, or legal change. At present, the technical review of property protection is as uncertain as the other nine themes.

The National Fire Chiefs Council (NFCC) published a *Single Staircases Policy Position Statement*, dated December 2022. Expressing disappointment with progress in the technical review process, the NFCC insisted, for residential buildings above a height of 18m or 7 storeys, that government should require more than one protected staircase in new developments, and retrofitting of sprinklers into existing high-rise Flats with only one protected staircase.

https://www.nationalfirechiefs.org.uk/write/MediaUploads/Position%20statements/Protection/NFCC_Position_Statement_Single_Staircases__Final.pdf

Thinking on means of escape is contested on more than the question of single stairs. Currently there is no definition of the "common building situations" addressed by the Ministry. Higher Risk Buildings (HRBs) are scoped outside of both Volumes of BDM01-16 (E-AD-B). Technical reviews are unpublished, and BRAC has been abolished by the Building Safety Act 2022. Consequently, building control inspectors often need to refer beyond statutory guidance when addressing the law for health and life safety.

The competitive building control inspection services market was expanded by the Building (Approved Inspectors etc.) Regulations 2010.

https://www.legislation.gov.uk/uksi/2010/2215/contents

Additionally, the continuing expansion of government approved competent persons schemes for categories of work where building control inspectors are not involved creates several paths through the building control process:

a. The work may be checked by a building control inspector, from either:

   i. Local Authority Building Control (LABC); or an

   ii. Approved Inspector.

b. Some types of work may be self-certified by a "competent person". This is a term for an installer who works under a competent person scheme that has been approved by the government.

Attempting some consensus, the Building Control Alliance (BCA) Technical Group comprises practitioners in building control from local authority and approved inspector backgrounds. They publish guidance for their inspectors, to assist them in understanding and applying the Building Regulations 2010, as amended.

https://buildingcontrolalliance.org/guidance-documents/

Some clients and their consultants or contractors may have selectively referred to BCA guidance before the Grenfell Tower Inquiry. However, BCA guidance was not approved by the Secretary of State under Section 6 of the 1984 Building Act. BCA guidance does not have the "imprimatur of government".

Some work will not involve a building control inspector and has no competent person scheme but must still comply with the Building Regulations. An example given in the *Manual to the Building Regulations* is loft insulation, unconnected to a material change of use or other building work. Some buildings are also exempt in Section A11, which includes Table A1 Classes on page 28, as follows:

Class 1

Buildings controlled under legislation for explosives, nuclear facilities or ancient monuments

Class 2

Certain buildings not visited by people, such as plant rooms

Class 3

Certain greenhouses, agricultural buildings and buildings for animals

Class 4

Temporary buildings not intended to remain in situ for more than 28 days

Class 5

Buildings used for site accommodation

Class 6

Certain small detached buildings, generally without sleeping accommodation

Class 7

Certain conservatories, porches and open-sided carports

Use of "certain" in the exempt Classes creates uncertainty about which buildings are exempt. The *Manual to the Building Regulations* advises confirmation should be obtained from a building control inspector that Building Regulations apply because not exempt as Table A1. Advice should also be sought when there is no need for inspection or a self-certification scheme, but the Building Regulations 2010 continue to apply as legislation. The Note in Table A1 refers to "approval" of a building control application in contrast to self-certification.

Two other points are objectives in the *Manual to the Building Regulations*:

- Page 24 – "Nothing in the Building Regulations or an approved document prevents you from adopting higher standards."

- Page 27 – "You should always rely on the text of the legislation in preference to relying on the summary in this manual."

What is not explained in the *Manual to the Building Regulations* is the case when the statutory guidance of the Approved Document fails to satisfy the law of the Building Regulations. In that case, compliance with the Ministry published but explicitly non-mandatory statutory guidance for "common building situations" may be a breach of Schedule 1 Requirements as BDM01-11, or possibly even a breach of the numbered Regulations in the Building Regulations 2010.

One of the objectives of BDM01 is to try to confront known cases where, even for the limited purposes of the law, the statutory guidance is proving insufficient.

Local Authority Building Control (LABC) represents all local authority building control teams in England and Wales.

https://www.labc.co.uk/

LABC published *Building Regulations and Fire Safety Procedural Guidance* in July 2020. This is essential reading even if LABC members are not appointed.

https://www.labc.co.uk/sites/default/files/2020-07/LABC.Building-Regulations-and-Fire-Safety-Procedural-GuidanceV2.150720.pdf

Competition in the provision of building control was introduced in 1985. As an alternative to the LABC for building control services, the members of the Association of Consultant Approved Inspectors (ACAI) are regulated by the Construction Industry Council Approved Inspectors Register (CICAIR).

https://theacai.org/

https://www.cicair.org.uk/

ACAI members are subject in England and Wales to the Building (Approved Inspectors etc.) Regulations 2010.

https://www.legislation.gov.uk/uksi/2010/2215

Scotland operates a Building Warrant system through Local Authorities. Applicants may use an Approved Certifier of either design or construction, appointed from a register, to assist with the building control process.

https://www.gov.scot/publications/making-quality-building-warrant-application-need-know/

https://www.gov.scot/publications/building-standards-customer-journey/

https://www.mygov.scot/approved-certification

Building Control Northern Ireland is a voluntary grouping of the building control departments of Local Authorities. Applications are made to Local Authorities, who since 1979 have discretionary powers to approve plans, and relax or enforce the Requirements of Building Regulations in Northern Ireland.

http://www.buildingcontrol-ni.com/

While building control approval is required, obtaining it is no guarantee that the Building Regulations in any devolved administration have been complied with. The building control process may not address where compliance with statutory guidance is insufficient for the purpose of health and life safety as the legal requirement. For any purposes beyond those in Building Regulations, the investor in buildings needs to go further than any building control process will consider.

6 Methodological thinking for BDM01 and BDM02

6.1 Document structure and relationships

This document, BDM01 *A to Z of Essential Principles* 2023, starts in Principle A with the investor's commitment to a Resilience Strategy as BDM01-4. The need for this commitment to a Resilience Strategy is explained by the limitations in the legislative framework as BDM01-5.

As the Essential Principles are developed, BDM01 2023 shall be read with BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022. BDM02 is the necessary core document to BDM01.

https://www.thefpa.co.uk/resource-download/405

BDM02 2022 was updated to relate fire resistance and maximum size of compartmentation to the *LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance*.

https://www.thefpa.co.uk/shop/lpc-sprinkler-rules-with-bsen12845-book

The Loss Prevention Council (LPC) publication passed to the FPA, and is known as the LPC Sprinkler Rules. The updated guidance provides two insurer supported options for property protection by augmenting BS EN 12845:2015+A1:2019. In BDM02 2022, any compartments fitted with life safety suppression systems are treated as "unsprinklered" and no extension of compartment size or relaxation of fire resistance in floors and walls can be warranted.

Therefore, sprinkler and watermist systems designed and installed to life safety standards can have little or no relevance to those with interest in additionally assuring the recoverability of the building and the activities conducted within it, such as the building owner or operator and their insurer, or the wider constituency of "Relevant Persons" discussed as Principle G.

In developing the Essential Principles following the Resilience Strategy of Principle A as BDM01-4, and building them around the core document BDM02 2022, a managed process of decision making through six phases is suggested:

- Phase 1 – Undertake Early Consultation
- Phase 2 – Prevent Fire Starting
- Phase 3 – Lower Property Loss
- Phase 4 – Enhance Design Robustness
- Phase 5 – Check Construction Achieved
- Phase 6 – Improve Facilities Management

The phasing suggests a plan of work for design and construction management discussed as BDM01-7. The early strategic choices, from project inception and before planning application, precede the later technical detail of construction after tendering for contract. All of this effort must result in a successful handover of information for facilities management, to be maintained over the life of the occupied building.

BDM01 2023 recognises this iterative process, but also appreciates that early strategic decisions profoundly affect later aesthetic, technical and managerial options. The investor needs to plan ahead.

6.2 A to Z Essential Principles title and descriptions

BDM01 2023 presents the Essential Principles as a memorable alphabetical list:

A Strategically Assess Resilience

B Engage Insurers Early

C Support Firefighting Operations

D Maximise Non-Combustibility

E Anticipate Arson Attempts

F Monitor Building Services

G Address Occupational Issues

H Extend Structural Stability

I Reduce Fire Severity

J Control Compartment Cavities

K Separate External Openings

L Resist Fire Ingress

M Expect Adverse Weather

N Minimise Consequential Damage

O Facilitate Simple Repair

P Plan Salvage Operations

Q Follow Identified Standards

R Provide Reliable Detection

S Complete Performance Tests

T Procure Quality Materials

U Require Competent Work

V Verify Recorded Information

W Manage Fire Safety

X Action Statutory Assessments

Y Keep Maintenance Commitments

Z Critically Review Experience

These principles have been given alphabetical order, and each letter has a memorable title to be extended into a description that can be used to "tag" either statutory or non-statutory guidance. The principles develop into a checklist as BDM01-9 and are discussed as BDM01-10 supporting notes.

The twelve principles that have been continued from BDM01 2015 are shown in [brackets]. Improvements through use will follow in future revisions of BDM01.

The A to Z of Essential Principles that all clients, consultants, contractors, and facilities managers should follow are shown below, with their descriptions.

Letter	Title + Description
Principle A	**Strategically Assess Resilience** Assess susceptibility, vulnerability, and recoverability in the structure, construction, and services systems against risks in fire, escape of water, and flooding, to define a strategy for the development project, to be critically reviewed over time.

Letter	Title + Description
Principle B	**Engage Insurers Early** Engage with professional indemnity, construction, defects, building, and contents insurers from the earliest Work Stage in project planning, to interrogate the value of the Essential Principles and optimise the insurability of the building in use.
Principle C	**Support Firefighting Operations** Consult with the Fire and Rescue Service to facilitate operations in pursuit of life safety with an emphasis on timely self-evacuation, understanding that rescue is a statutory obligation, but protection of the asset requires additional measures.
Principle D [2015 Principle 2]	**Maximise Non-Combustibility** Use non-combustible construction materials and products in systems, elements, and spaces, so far as reasonably practicable, as methods of construction that make minimal contribution to fire development and the generation of smoke.
Principle E [2015 Principle 9]	**Anticipate Arson Attempts** Introduce measures to prevent, so far as reasonably practicable, an anticipated arson attack from an external fire source either thrown or positioned to cause damage anywhere within and around the building, particularly at lower storeys.
Principle F [2015 Principle 12]	**Monitor Building Services** Ensure all building services, including local sources of renewable energy or mains utilities connections, are designed, installed, commissioned, and maintained to prevent them being a cause of fire ignition, smoke spread, or water damage.
Principle G	**Address Occupational Issues** Address the design, construction, management, and rearrangement of the building to specific hazards and risks facing occupants as "Relevant Persons", occupying either a building in an identified purpose group or a mixed-use facility.
Principle H [2015 Principle 3]	**Extend Structural Stability** Engineer against structural collapse and excessive deflection within compartment walls and floors, to accommodate all imposed loads in fire situations, beyond the statutory life safety requirement and risk of accidental disproportionate collapse.
Principle I [2015 Principle 1]	**Reduce Fire Severity** Compartmentalise and fully protect the building with a sprinkler system so that if a fire starts, the extent of fire, heat, and smoke damage should be minimised and confined in the compartment of origin, so far as reasonably practicable.
Principle J	**Control Compartment Cavities** Design out cavities within the internal compartment walls and floors, so far as reasonably practicable, and where cavities are necessary, provide cavity barriers or fire stopping to prevent extensive routes for flame, heat, and hot or cold smoke.
Principle K	**Separate External Openings** Slow the speed of external fire growth beyond the compartment of origin within external walls and soffits, separating openings with fire resisting construction, including attachments such as balconies, so far as reasonably practicable.

Letter	Title + Description
Principle L [2015 Principle 10]	**Resist Fire Ingress** Resist external fire ingress into the premises by party wall separation from any adjoining building, sterilisation of roofs, and control of external fire resistance with distance between neighbouring buildings, so far as reasonably practicable.
Principle M	**Expect Adverse Weather** Protect the building envelope against degradation from incident solar radiation, wind, and water, interrelated to thermal cycles, anticipating prospects of flooding, high rainfall, drought, and high wind, which may also complicate the event of fire.
Principle N [2015 Principle 4]	**Minimise Consequential Damage** Invest in measures to limit the extent of damage caused by heat, smoke, and water in the event of fire, and by escape of water incidents, ensuring assets and the environment are minimally affected, so far as reasonably practicable.
Principle O	**Facilitate Simple Repair** Develop the design to technically resolve how a partially damaged building can be cost effectively repaired and be vigilant against proposed changes in construction Work Stages that diminish repairability, which should be declined under contract.
Principle P	**Plan Salvage Operations** Plan enhanced protection and subsequent salvage of valuable building contents, so far as reasonably practicable, including any important or irreplaceable furniture, fixtures, and equipment, in ways compatible with firefighting operations.
Principle Q	**Follow Identified Standards** Identify and closely follow standards for life safety and asset protection, avoiding selective "cherry picking" between standards, fully disclosing test reports and fire engineering assessments signed and dated by competent Fire Engineers.
Principle R [2015 Principle 7]	**Provide Reliable Detection** Install a comprehensive automatic fire alarm system based on high-integrity detectors to prevent false alarms, so far as reasonably practicable, installed and commissioned by specialist operatives who should also provide user training.
Principle S	**Complete Performance Tests** Programme and decisively complete specified and contracted performance testing, inspection, and certification to show compliance, and achieve client acceptance of results in a timely manner, to prevent performance deficiencies under contract.
Principle T [2015 Principle 5]	**Procure Quality Materials** Insist upon the procurement of materials, products, and systems with third party certification schemes accredited by the United Kingdom Accreditation Service, with proof of service life in application and full disclosure of fire safety information.
Principle U [2015 Principle 6]	**Require Competent Work** Confirm protection measures are installed by identified specialists, trained and supervised under third party quality of work schemes accredited by the United Kingdom Accreditation Service, with full disclosure of fire safety information.

Letter	Title + Description
Principle V	**Verify Recorded Information** Accept only pertinent and accurate information at handover, insisting contractors satisfy statutory and contractual duties, checking record information provides full disclosure of the premises as built and commissioned for facilities management.
Principle W [2015 Principle 11]	**Manage Fire Safety** Provide fire safety management services to the satisfaction of the statutory duty holders appointed by the building owner and, if different, the building operator, including induction and training in fire safety for building users on the premises.
Principle X	**Action Statutory Assessments** Instruct, review, and promptly act upon Fire Risk Assessments that consider the scale or complexity of the building and the activities undertaken by building users on the premises, keeping a written record of assessments and actions over time.
Principle Y [2015 Principle 8]	**Keep Maintenance Commitments** Inspect regularly, test and, when required, promptly maintain or replace structure, construction or building services systems over the life of the building, employing specialist operatives trained and supervised under third party certified schemes.
Principle Z	**Critically Review Experience** Review whether the aspects of resilience originally required of the asset were realised practically over time, and share lessons learned to strengthen a culture of disclosure which can inform insurable strategies for future development projects.

6.3 Adopting the Plan of Work from the Royal Institute of British Architects

Managed processes provide established and explicit frameworks that assist with successful project delivery, whether for new buildings or in the refurbishment of existing facilities. The planning of Work Stages leads to a programme of decision making between numerous parties involved in a project over time.

The Royal Institute of British Architects (RIBA) has historically set the Work Stages widely used in the UK construction industry. The latest iteration is the *RIBA Plan of Work 2020*, freely available online. Guidance publications are also available.

https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work

https://www.architecture.com/-/media/GatherContent/Test-resources-page/Additional-Documents/2020RIBAPlanofWorkoverviewpdf.pdf

Other construction professions relate to the RIBA lead. The *IStructE Plan of Work 2020* from the Institution of Structural Engineers (IstructE) coordinates with the *RIBA Plan of Work 2020*, providing clarity over structural engineering roles and deliverables. This improves collaboration with other design, construction, and project management disciplines.

https://www.istructe.org/resources/guidance/the-structural-plan-of-work/

IStructE recognise the importance of preparing a shared "Movements and Tolerances Report", which both qualifies and quantifies the anticipated movements during the lifetime of a building, the tolerances to be achieved during construction, and the design solutions to accommodate these movements and tolerances. That understanding develops through Work Stages.

The *RIBA Plan of Work 2020* is a flexible decision-making cycle of Work Stages which has been developed to suit any of the Joint Contracts Tribunal (JCT) contract families providing different procurement routes.

https://www.jctltd.co.uk/category/contract-families

The Work Stages allow flexibility on when the important planning and building control applications are made, and when the works are tendered for contract in relation to the design phase. This flexibility of eight Work Stages gives an organisational armature for project managers across the design and construction phases through to "Practical Completion" at Work Stage 6 handover.

0 – Strategic Definition

1 – Preparation and Briefing

2 – Concept Design

3 – Spatial Coordination

4 – Technical Design

5 – Manufacturing and Construction

6 – Handover

7 – Use

The plan of work is constantly under review. Following the Grenfell Tower fire, an Expert Advisory Group on Fire Safety was established at the RIBA, chaired by Jane Duncan. The RIBA are committed to mandatory professional competence in health and life safety, and that commitment is strengthening the application of the *RIBA Plan of Work 2020* to project based work across the architectural profession.

https://www.architecture.com/knowledge-and-resources/knowledge-landing-page/five-years-after-grenfell-jane-duncan-reflects

It is expected that the eight Work Stages will continue to provide discipline for construction project management in future. Protocols for fire safety are undergoing significant reform but the *RIBA Plan of Work 2020* is providing a continuity of thought that relates to contracting in a tangible way.

https://www.architecture.com/-/media/GatherContent/Plan-of-Work-for-Fire-Safety-Consultation/Additional-Documents/RIBAPlanofWorkforFireSafetyConsultationDocumentpdf.pdf

The Essential Principles are mapped to the RIBA Work Stages as BDM01-7.

6.4 Passive fire protection through compartmentation

Passive fire protection has a core strategy of compartmentation. In the statutory guidance from the devolved administrations of England, Scotland, Wales, and Northern Ireland this is defined in terms of compartment floor area (m2) and the fire resistance of compartment floors and walls (Minutes). Fire resistance tends to be specified to BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*. This product standard for fire resistance classification is under review, but categories of Stability (R), Integrity (E), and Insulation (I) as the combination of (REI) are established.

Statutory guidance to Building Regulations in the four devolved administrations addresses Purpose Groups of buildings in different ways, but all assign a maximum compartment size with a fire resistance depending on whether sprinklers are installed or not. In some Purpose Groups, concessions on compartmentation are made for the installation of sprinklers.

Yet the Building Regulations for fire safety are legally devoted to health and life safety, and so is the statutory guidance. The Building Regulations and the caveated statutory guidance that annotate them in practical terms nowhere mandate the protection of property from collapse after everyone has vacated the premises to a place of safety outside. Property owners are expected to insure against property loss.

Changes to building methods and materials are affecting the "fire compartment" approach and raise significant challenges for property protection.

When walls and floors are of solid, non-combustible and fire resisting construction, the fire compartments may be considered contiguous and simple in structure. The development of stone, brick or block masonry walls, and later of insitu or precast reinforced concrete for walls and floors, brought solidity and non-combustibility to compartmentation that could be engineered for fire resistance. The substitution of steel columns and beams for concrete in framed primary structures changed little for the compartment floor slabs that relied on insitu or precast concrete.

The development and approval of "lightweight" external wall constructions occurred throughout the twentieth century, supported by wind braced primary structural frames of columns and beams, with solid, non-combustible, and fire resisting concrete floor slabs as horizontal internal compartmentation. By the 1960s, the external wall was increasingly not thought of as a compartment wall like the internal walls, and non-fire resisting "curtain wall" became common beyond the office Purpose Group.

In the twenty first century, however, the internal use of "lightweight" constructions in all Purpose Groups introduces cavities with an increasing choice of combustible materials, not only in compartment walls but in compartment floors. Modern Methods of Construction (MMC) often involve an interconnection of voids formed of frequently combustible materials. The preference for timber is noticeable, not only as non-loadbearing infill to a framed primary structure, but also as the primary structure in new structurally engineered forms.

In much MMC, the fire resistance is usually provided by a lining of Gypsum based plasterboard, often on a single side facing the accommodation. Quite often, pairs of single lined walls are built for acoustic separation. In Modular construction, defined in the BDM01-14 Short glossary of terms as Category 1 MMC, there is no longer a solid compartment floor slab.

The increasing assumption is that the fire resistant linings to walls and floors will prevent fire, if not water, from entering the cavities within the compartmentation, at least for long enough to provide the legal minimum for health and life safety, as BDM01-5, regardless of whether the construction is combustible.

Lined walls and floors are often fire resistance tested vertically and horizontally as 2D constructions to BS EN 13501-2: *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*. The fire resistance performance achieved at 3D joints or interfaces cannot be determined from 2D testing. The supporting structure will move differentially and distort when exposed to heat in a fire situation. Gaps may open to expose the cavities within the construction to fire, heat, and smoke.

The challenge for building resilience is that once the fire resistance of the lining has been surpassed, fire, heat, and smoke may enter into a cavity within the compartment walls or floors, accessing any combustible materials.

If those cavities within compartmentation are extensive, there is a labyrinthine route for massive fire spread beyond the compartment of origin. Moreover, those cavities are in locations that cannot be actively fire protected by accommodation suppression systems, and are out of sight and reach of Fire and Rescue Service intervention.

In this MMC, reliance must be on fastidious placement of fire stopping rather than mere cavity barriers to an accuracy in 100% of instances that might be considered unfeasible. Compartments might now exist in a combustible lattice of voids.

BDM01 *A to Z of Essential Principles* explicitly addresses the changing character of fire resisting compartmentation, and raises the need for compartmentation to include the external wall. This is a matter affecting the insurability of architectural form and function, most obviously in fenestration, and the trajectory of MMC into the construction industry market of the 2030s and 2040s.

Without effective compartmentation for passive fire protection of property in a Resilience Strategy, insurers have to recalibrate their calculation of loss based on the presence of factors such as extensive cavities, combustible materials, and fire resistance limited to a minimal Evacuation Strategy for health and life safety.

The importance of consultation to achieve insurability is discussed further in Principle B, articulated in a checklist as BDM01-9.2 with supporting notes as BDM01-10.2. Compartmentation is directly addressed as Principle I, as BDM01-9.9 checklist and BDM10.9 supporting notes. The interdependency of the Essential Principles involves an iterative process of decision making in the design and construction phases of any project, but compartmentation is a core strategy.

BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022 presents to the insurer property protection requirements in compartmentation, as a Purpose Group table for compartment size and fire resistances. The 2D to 3D performance question remains to be answered in a Movements and Tolerances Report for the non-fire and fire situations.

https://www.thefpa.co.uk/resource-download/405

Concessions in compartmentation are only obtained through insurer recognised suppression systems. BDM02 2022 shows the concessions in compartmentation obtained with a suppression system installed to the LPC Sprinkler Rules.

6.5 Active fire protection through suppression

Active fire protection systems can be designed to support health and life safety but not all provide sufficient property protection.

Suppression systems that only support health and life safety have some role in assisting occupants of the compartment of fire origin, but should also be designed to maintain the tenability of escape routes during a fire event to assist occupants evacuating from other compartments. They have no role to play once the building Evacuation Strategy is complete, as discussed in Principle C. While they can provide some benefit in terms of alarm function, they offer little by way of property protection capability due to their generally short periods of operation.

Suppression systems additionally designed for property protection achieve a set protection goal and generally must function for a timescale much longer than that dictated by the Evacuation Strategy for a building. They are a component of a Resilience Strategy in association with enhanced compartmentation.

It is vital to recognise the difference between "suppression" and "extinguishing" systems. The words are often used interchangeably to mean both.

- Extinguishing systems are designed to end the fire event and secure against reignition within the compartment, without the need for further intervention by the Fire and Rescue Service.
- Suppression systems contain and prevent the spread of fire only for a period of time. While they may in effect extinguish the fire, they are designed on the basis that ultimately intervention by the Fire and Rescue Service within the compartment will be required to assure the fire event is ended.

The most common and relied upon system used for building property protection is the suppression sprinkler system designed to insurer standards, characterised by high reliability of function and long operation periods coherent with Fire and Rescue Service attendance times. Insurer valued sprinkler systems account for the protection of billions of pounds of UK building stock.

Sprinkler systems valued by insurers are those installed in accordance with one of the two options in the *LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance*.

https://www.thefpa.co.uk/shop/lpc-sprinkler-rules-with-bsen12845-book

The LPC Sprinkler Rules include Technical Bulletin TB206: 2020 Rev 1 *Passive fire protection of sprinklered buildings*, which in Tables T1 and T2 provides the two insurer supported options for installation. They are Table T1 without exceptions, and Table T2 with permitted and necessary exceptions.

More fully explained in BDM02 2022, compartments with health and life safety suppression systems are treated as "unsprinklered" and no extension of compartment size or relaxation of fire resistance in floors and walls can be warranted. Even with property protection suppression systems to the LPC Sprinkler Rules, compartmentation concessions are limited in some Purpose Groups.

Other property protection focused sprinkler installation rule sets, such as those produced by Factory Mutual (FM) and National Fire Protection Association (NFPA), may be considered equivalent to the LPC Sprinkler Rules. However, this should be confirmed in consultation with the building insurer, as Principle B.

As construction methods change through MMC, so too will the sets of sprinkler rules for property protection. The LPC Sprinkler Rules are constantly reviewed.

BDM02 is at the core of BDM01, and together they address the activities of both passive and active fire protection sectors working to realise the property protection enhancements valued by the insurance market.

6.6 Fire classification of construction products and building elements

The following standards in the BS EN 13501 series for fire classification of construction products and building elements are referred to:

- BS EN 13501-1:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests*
- BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*
- BS EN 13501-3:2005+A1:2009 *Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers*
- BS EN 13501-4:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests on components of smoke control systems*
- BS EN 13501-5:2016 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests*
- BS EN 13501-6:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests on power, control and communication cables*

These standards may be revised before the next revision of BDM01. There is also closer scrutiny of their veracity as classification systems, based on tests that might give a false sense of confidence, or reporting conventions that provide insufficient information. For example the obvious question for BS EN 13501-1 is whether it says very much about surface spread of flame in contrast to combustibility.

BDM01-13 provides descriptions of test equipment used in the four test standards referred to in Table 1 of BS EN 13501-1:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests* for construction products considered in Principle D:

13.1	BS EN ISO 1182	Furnace Test
13.2	BS EN ISO 1716	Bomb Calorimeter Test
13.3	BS EN 13823	Single Burning Item Test
13.4	BS EN ISO 11925-2	Single Flame Test

BDM01 does not advocate system scale testing as a substitute for product scale testing. Before the Grenfell Tower fire, it was sensible to see product and system scale testing as complementary, and even sequential. A prelude of product scale testing, with a view to classification, was understood as a useful specification filter to avoid the need for expensive system testing. Information obtained at both scales can inform design phase decisions, but some system scale testing may conceal product performance if the product scale testing is not undertaken initially.

The cladding system at Grenfell Tower had never been system tested to a large scale using BS 8414. It was argued that if such testing had been completed prior to the refurbishment, the proposed system would have failed, and another, presumed safer system would have necessarily been tested and adopted. The argument was that such system testing should have been mandatory. BS 8414 was optional in non-mandatory but statutory guidance after 2002, and has been amended to the current pair of standards:

- BS 8414-1:2020 *Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to, and supported by, a masonry substrate*
- BS 8414-2:2020 *Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to, and supported by, a structural steel frame*

The technical development of BS 8414 as a system test need not distract from the issue of product testing. The post-Grenfell argument in favour of compulsory system testing to BS 8414 missed the point that the classification, and therefore testing, of cladding product in English statutory guidance before the Grenfell Tower fire was flawed. A smaller scale product classification was inadequate.

At no time was cladding product expected to be non-combustible or even of "limited combustibility" by the non-mandatory but statutory guidance that had the "imprimatur of government" in England.

At the time, the following definitions applied in BDM01-16 (E-AD-Bv2)(2006 as amended 2010 and 2013), based on testing to BS EN 13501-1:

- Table A6 – Non-combustible materials – Class A1
- Table A7 – Materials of "limited combustibility" – Class A2

Each had a National test in the BS 476 series, through Parts 4 or 11. However cladding product as distinct from insulation product was approved Class 0, which had a National test in the BS 476 series, through Parts 6 and 7. Further, between 2000 and 2002, National Class 0 had been erroneously transposed to European Class B under BS EN 13501-1. Cladding products obtaining National Class 0 could also be European Class C, D or E, and highly combustible.

This distinction and transposition error, disclosed with previously unpublished evidence during the Grenfell Tower Inquiry, are discussed further for Principle D as BDM01-9.4, with supporting notes as BDM01-10.4. This discussion considers detail about testing for smoke (s) and melting droplets (d) that additionally feature in the European classification standard BS EN 13501-1, and not in the BS 476 series.

The Scottish statutory guidance after 2005 had elided the English definitions to mean non-combustible as Class A2, but had applied Class A2 to both insulation and cladding product on high-rise buildings. That was not the case in England.

If cladding product in English statutory guidance had been expected to be Class A2 or "limited combustibility" on high-rise buildings, as only external wall insulation products were for buildings with a storey height of over 18m above ground, and if such statutory guidance had been followed in design and construction, events would have been different. The Grenfell Tower fire would not have happened and, more widely, the now discovered and widespread problem of combustible Class 0 cladding in built stock would not have been created after 2000.

The problem was in the product classification of Class 0 for cladding, not because BS 8414 system testing was voluntary. Indeed, the optional BS 8414 testing allowed combustible product manufacturers to circumvent the English expectation in statutory guidance that external wall insulation was otherwise at least Class A2 or "limited combustibility" on high-rise buildings.

BDM01 has resisted the argument that product testing is inferior to system testing when it is flawed product classification in statutory guidance that has been criticised by the Grenfell Tower Inquiry, with evidence only published in 2022.

The flaw in Class 0, allowing combustible cladding to the market, is important in recent construction history. It is not to be disregarded by an appeal for mandatory system testing when reliable product testing is required for Principle D.

That is not to argue combustibility testing in BS EN 13501-1 is without technical criticism, or that the other Parts of the BS EN 13501 series are perfect. No test methods can be perfect, and a future revision of BDM01 may address the BS EN 13501 series more coherently. However, testing in BS EN 13501-1 for the classification of combustibility is to be preferred to the flawed tests that BS 476 Parts 6 and 7 have proved to be when used to assess Class 0.

This issue of product versus system scale testing was not resolved by the option of Loss Prevention Standards (LPS) published by the Loss Prevention Certification Board (LPCB) as enhanced property protection versions of BS 8414 Parts 1 and 2:

- LPS 1581: Issue 2.1 *Requirements and tests for LPCB approval of non-load bearing external cladding systems applied to the masonry face of a building*
  https://www.redbooklive.com/download/pdf/LPS1581.pdf
- LPS 1582: Issue 1.1 *Requirements and tests for LPCB approval of non-load bearing external cladding systems fixed to and supported by a structural steel frame*
  https://www.redbooklive.com/download/pdf/LPS1582.pdf

Insurers have long encouraged investors to adopt an LPS approach, but property protection standards are not recognised anywhere in statutory guidance for health and life safety. The full list of insurer preferred standards is freely available to download in the LPCB *Redbook Live*.

https://www.redbooklive.com/lps.jsp

The history of insurer involvement in standards setting started in 1825. The effort to encourage investors to practically protect their investment requires renewal.

https://aim25.com/cats/118/17180.htm

BDM01 is based in product scale testing as Principle D.1, and not only for the external wall. System testing to BS 8414 for the external wall is addressed as Principle D.7, with a supplementary consideration of Building Control Alliance (BCA) guidance in Principle D.8. Testing at the product scale is recommended.

Failure to test at the product scale may have consequences. In the Supreme Court of New South Wales, Australia, the failure to ensure there was a product scale combustibility test for an Aluminium Composite Panel (ACP) as actually procured on a building, and whether the product was installed in accordance with the manufacturers' specifications for the application, was considered in *Strata Plan 92450 v JKN Para 1 Pty Ltd & Anor [2022] NSWSC 958*, with a decision on 19 July 2022. The judgement went back to the failure to test product and verify the work.

https://www.caselaw.nsw.gov.au/decision/18210882bba27fc6b149f2be

An ACP is an Aluminium Composite Material (ACM) in UK statutory guidance.

Principle D for combustibility is not read in isolation. NSWSC 958 illustrates, and no doubt other cases that will be brought in the UK will show, that safety critical products should be purposefully selected early in the design phase. These product selections are important in the Resilience Strategy. The individual products may require subsequent system testing and assessment, whether later in the design phase or during the construction phase. However the strategic selection of safety critical products may begin with a focus on their combustibility as Principle D.

Other factors, such as their susceptibility to water damage, may be anticipated in Principle N for consequential damage, and Principle O for simple repair.

Product selection in the Resilience Strategy requires validation. The design development and construction process should be based in specified standards as Principle Q, performance tested as Principle S, procured as Principle T, constructed as Principle U, and the whole process verified as Principle V before the building is occupied. However, it is the Resilience Strategy that provides the purpose for decisions extending into facilities management.

The Essential Principles are related as a decision making process:

D	Maximise Non-Combustibility
N	Minimise Consequential Damage
O	Facilitate Simple Repair
Q	Follow Identified Standards
S	Complete Performance Tests
T	Procure Quality Materials
U	Require Competent Work
V	Verify Recorded Information

The Essential Principles in BDM01 are read together. They provide an iterative and interdependent approach to building and design management as a plan of work to enhance insurability, based in the Resilience Strategy of Principle A.

7 Ordering the Essential Principles with the *RIBA Plan of Work 2020*

7.1 Diagram of eight Work Stages in six phases for decision making

Using the six phases as BDM01-6.1, the twenty six alphabetical Essential Principles as BDM01-6.2 are presented as an iterative decision making process mapped to the eight Work Stages in the *RIBA Plan of Work 2020* as BDM01-6.3.

Work Stage 0 for the investor will begin in commercial considerations even before they start thinking about their Resilience Strategy as Principle A.

RIBA Plan of Work 2020	Principles	Description	Phase
Work Stage 0 Strategic Definition	A	Strategically Assess Resilience	1 Undertake Early Consultation
	B	Engage Insurers Early	
Work Stage 1 Preparation and Briefing	C	Support Firefighting Operations	
	D	Maximise Non-Combustibility	2 Prevent Fire Starting
	E	Anticipate Arson Attempts	
Work Stage 2 Concept Design	F	Monitor Building Services	
	G	Address Occupational Issues	3 Lower Property Loss
	H	Extend Structural Stability	
Work Stage 3 Spatial Coordination	I	Reduce Fire Severity	
	J	Control Compartment Cavities	
	K	Separate External Openings	
Work Stage 4 Technical Design	L	Resist Fire Ingress	
	M	Expect Adverse Weather	
	N	Minimise Consequential Damage	
	O	Facilitate Simple Repair	4 Enhance Design Robustness
	P	Plan Salvage Operations	
	Q	Follow Identified Standards	
Work Stage 5 Manufacturing and Construction	R	Provide Reliable Detection	
	S	Complete Performance Tests	5 Check Construction Achieved
	T	Procure Quality Materials	
Work Stage 6 Handover	U	Require Competent Work	
	V	Verify Recorded Information	6 Improve Facilities Management
Work Stage 7 Use	W	Manage Fire Safety	
	X	Action Statutory Assessments	
	Y	Keep Maintenance Commitments	
	Z	Critically Review Experience	

Figure BDM01-7.1.1 *RIBA Plan of Work 2020* and the A to Z – RISCAuthority

The project programme flows through the six Phases, which are not intended to correspond to the eight Work Stages in the *RIBA Plan of Work 2020*. In this way, the A to Z of Essential Principles has a loose fit to any plan of work.

The emphasis on early consultation is sensible and has strategic purpose.

7.2 Phase 1 – Undertake Early Consultation

The *RIBA Plan of Work 2020* describes a managed process of decision making as the personnel involved increase from those initiating the project to a larger division of labour. Investors will be acting either as or through the client. Early strategic decisions by the client team are profoundly important.

Work Stage 0	**Strategic Definition** Only the client team is involved at Work Stage 0. An experienced client can review feedback from previous projects, but a novice client may be defining a strategy for the first time. A client should consider how investment in an asset will affect their resilience as an enterprise, as Principle A. The RIBA recommend that clients identify policy and legislation, while RISCAuthority recognises the Resilience Strategy as BDM01-4. The client team may seek advice from a wide range of professionals to define the project strategy for property or asset protection, or resilience as Principle A, in addition to health and life safety requirements. The advice of insurers is readily available to a client from the outset, as Principle B.
Principle A	**Strategically Assess Resilience**
Principle B	**Engage Insurers Early**
Work Stage 1	**Preparation and Briefing** Only the client team is involved at Work Stage 1. To identify needs of the client and the project, Feasibility Studies are undertaken which may require architectural skills, and engineers or surveyors may assess key Project Risks. It is necessary to anticipate the building users as "Relevant Persons" as Principle G, and to consider the facilities manager who will serve them. Fire safety issues for a new site or an existing building should be discussed with the Fire and Rescue Service as Principle C, to inform the Project Brief. Access to facilities for firefighting with arrangement and location of cores should be raised. Specialist fire safety consultants may assist.
Principle C	**Support Firefighting Operations** The Project Brief may adopt Principles D and E as preventive measures. The decision to maximise non-combustible construction and anticipate arson attempts, whether by strangers or building users, will help to prevent fires starting.

7.3 Phase 2 – Prevent Fire Starting

Principle D	Maximise Non-Combustibility
Principle E	Anticipate Arson Attempts
Work Stage 2	Concept Design The client team begins working with their design team at Work Stage 2. Design team appointments include any specialist consultants, to achieve an Architectural Concept that is both robust and aligned with the Project Brief. Under some procurement routes the construction team may also be engaged early. A record of design decisions in the Fire Strategy is part of the Stage Report. Concepts will respond to consultation with the appointed building control inspector about fire safety. The architect will have access to building services engineers, and Principle F can be adopted to help prevent fire starting by monitoring utilities and services.
Principle F	Monitor Building Services By Work Stage 2, much more is known about the expected occupants and the kind of structure that is either envisaged for a new building or understood by Surveys of existing buildings. Principles G and H require conceptual design work.

7.4 Phase 3 – Lower Property Loss

Principle G	Address Occupational Issues
Principle H	Extend Structural Stability
Work Stage 3	Spatial Coordination The "Lead Designer" will be coordinating the consultant design team at Work Stage 3, undertaking Design Studies and Engineering Analyses. They will review compliance with at least Regulation 7 and Parts A, B and M of Schedule 1 Requirements of the Building Regulations 2010, with input from the building control inspector and the Fire and Rescue Service. The Stage Report will record of how design decisions are responding to identified risks in the Fire Strategy. The practical design responses should include Principles I, J and K for lower property loss, prior to submission of a Planning Application when the client is satisfied.
Principle I	Reduce Fire Severity
Principle J	Control Compartment Cavities
Principle K	Separate External Openings
Work Stage 4	Technical Design The "Lead Designer" is instructed by Work Stage 4 to coordinate the consultant design team and specialist contractors to suit a procurement route. The "Principal Designer" will initiate the Health and Safety File as pre-construction information under the Construction (Design and Management) Regulations 2015. While the design at Work Stage 4 should comply with Regulation 7 and Parts A, B and M of Schedule 1 Requirements of the Building Regulations 2010, other aspects of the building control application may be resolved at Work Stage 5. Further Principles L, M and N for lower property loss should be technically addressed.
Principle L	Resist Fire Ingress
Principle M	Expect Adverse Weather
Principle N	Minimise Consequential Damage The robust fire safe building design may be enhanced with insurer and warranty provider conditions for Principles O, P and Q through the Employer's Requirements before the client tenders for a contractor to be the "Principal Contractor".

7.5 Phase 4 – Enhance Design Robustness

Principle O	Facilitate Simple Repair
Principle P	Plan Salvage Operations
Principle Q	Follow Identified Standards
Work Stage 5	**Manufacturing and Construction** The appointed "Principal Contractor" continues the Health and Safety File under the Construction (Design and Management) Regulations 2015 and is responsible for site fire safety in Work Stage 5. The construction team reports to them. The procurement route determines further involvement of the design team. All aspects of the building control application are to be resolved under the contract before Work Stage 6. Importantly for life safety and property protection, the *RIBA Plan of Work 2020* suggests provision of a reliable detection and alarm system interfaced with other fire safety systems. Principle R enhances the robust design.
Principle R	**Provide Reliable Detection** Instead of a clerk of works, the client team may include compliance monitoring specialists to check construction, perhaps appointed from the consultants in Work Stages 2 to 4. Principles S and T help to demonstrate compliance.

7.6 Phase 5 – Check Construction Achieved

Principle S	**Complete Performance Tests**
Principle T	**Procure Quality Materials**
Work Stage 6	**Handover** Acceptable proof of compliance with Regulation 7 of the Building Regulations 2010 is pivotal at Work Stage 6, requiring scrutiny through Work Stages 4 and 5. The project Contract Administrator determines Practical Completion with a Defects List that allows the building to be used safely over the Defects Liability Period. The patent defects should not make the Regulation 38 Fire Safety Information exchange unacceptable. Any latent defects are addressed if they arise. Incidences of poor work may manifest later, even when materials, products and systems are of specified and tested quality, but Principle U provides confidence.
Principle U	**Require Competent Work** In England and Wales, Regulation 38 of the Building Regulations 2010 addresses the Fire Safety Information exchange for the "Responsible Person" appointed under the Regulatory Reform (Fire Safety) Order 2005, requiring verification as Principle V. The differences in Scotland and Northern Ireland are discussed as Section 8. This revision of BDM01 will refer to the "Responsible Person" and the need for the Regulation 38 Fire Safety Information exchange.

7.7 Phase 6 – Improve Facilities Management

Principle V	**Verify Recorded Information**
Work Stage 7	**Use** Through Work Stage 7, sufficient time and funding are required for training and instruction in maintenance requirements for the facilities manager and staff. They possess the Regulation 38 Fire Safety Information exchange, the CDM 2015 Health and Safety File and the Building Manual. The "Responsible Person", as the statutory duty holder, shall arrange regular Fire Risk Assessments ensuring the competency of the fire risk assessor. These assessments support the building owner or operator and their facilities manager in Principles W, X, Y and Z. Post Occupancy Evaluations over the life of the building are part of a critical review.
Principle W	**Manage Fire Safety**
Principle X	**Action Statutory Assessments**
Principle Y	**Keep Maintenance Commitments**
Principle Z	**Critically Review Experience** Eventually the materials, products, and systems that comprise the building will reach the end of their service life after maintenance and repair. Replacement will be required, and larger refurbishment projects will return to Work Stage 0. The learning of repeat investors and the many professionals they have employed, all having engaged with the issues that concern insurers, is communicated to the next project in any organisation that can gain advantage from intelligent feedback.

8 Appointments to roles with responsibilities for resilience

The "Responsible Person" is usually appointed for handover at Work Stage 6 under the Regulatory Reform (Fire Safety) Order 2005 (RR(FS)O 2005) in England and Wales, to receive the Regulation 38 Fire Safety Information exchange.

Fire safety law is different in Scotland. Instead of the RR(FS)O 2005, it is the Fire (Scotland) Act 2005 and the Fire Safety (Scotland) Regulations 2006, as amended, that apply. In Scottish law the statutory duty holder is the employer, and there is no separate role of an appointed "Responsible Person". The Building Regulations are different to those in England and Wales.

https://www.legislation.gov.uk/asp/2005/5/contents

https://www.legislation.gov.uk/ssi/2006/456/contents

The Fire and Rescue Services (Northern Ireland) Order 2006 and the Fire Safety Regulations (Northern Ireland) 2010 also set statutory duties on the employer. The Building Regulations are different to those in England and Wales.

https://www.legislation.gov.uk/nisi/2006/1254/contents

https://www.legislation.gov.uk/nisr/2010/325/contents

This revision of BDM01 will refer to the "Responsible Person" and the need for the Regulation 38 Fire Safety Information exchange. A responsible person requires Fire Safety Information exchange in Scotland and Northern Ireland too.

In a future revision of BDM01, the document will be rephrased to better reflect the role of a statutory duty holder across all of the four devolved administrations. But even in England and Wales, the law is changing with the Building Safety Act 2022.

https://www.legislation.gov.uk/ukpga/2022/30/contents

In the Building Safety Act 2022, Section 72 provides the meaning of "Accountable Person" and Section 73 provides the meaning of "Principal Accountable Person" for Higher Risk Buildings (HRBs). The Building Safety Regulator (BSR) has a duty towards the "Relevant Persons" listed in Section 4(3), which includes residents in HRBs and each "Accountable Person" having an interest.

The Building Safety Act 2022 is being developed through secondary legislation and will be amended before the roles of statutory duty holders become established.

This revision of BDM01 2023 does not refer to the "Accountable Person" narrowly defined for HRBs under the Building Safety Act 2022. Instead, for temporary convenience, it is referring to the "Responsible Person" of the RR(FS)O 2005, although this is unsatisfactory for Scotland and Northern Ireland.

In England and Wales, the prospective building owner or operator may appoint a "Responsible Person" earlier in the construction phase, or even during the design phase. That early appointee should be able to assist in the project development and check the Regulation 38 veracity in advance.

The law of the RR(FS)O 2005 does not mandate this, but any of the four families of construction contract may allow an early appointment by the client on behalf of investors. They may then be involved in the Resilience Strategy as BDM01-4.

Clients who are building speculatively may reasonably object that they do not know who the resultant building owner or operator will be. In this case, the client may appoint a natural person to act as their proxy for the "Responsible Person" under the RR(FS)O 2005. This is suggested in Principle A.5 from Work Stage 2.

Whether a natural person for the client or the "Responsible Person" for the building owner or operator, there shall always be someone thinking actively about health and life safety and the resilience of the endeavour.

RIBA Plan of Work 2020	Work stage 0 Strategic Definition	Work stage 1 Preparation and Briefing	Work stage 2 Concept Design	Work stage 3 Spatial Coordination	Work stage 4 Technical Design	Work stage 5 Manufacturing and Construction	Work stage 6 Handover	Work stage 7 Use
Traditional Contracts	Small portions of the design may be required from a Main Contractor	Lead Designer is the Architect and able to initiate the building envelope	Project relies on tested proprietary construction with known detailing	Project may not be large or complex enough for façade specimen testing	Lead Designer must complete the design through the construction stage	Successful Main Contractor has a Contractor Design Portion at tender	Lead Designer acts as or advises the Project Leader to completion	Clients provide useful feedback to Designers and Contractors
Design and Build Contracts	Scoped design work shall be completed by the Main Contractor	Coordinating Designer may be a more specialised Consultant	Client's Design Consultants may be retained or novated at tender	Scope of façade specimen testing shall be defined in tender documents	Successful Main Contractor shall complete contract Design Intent	Novated Design Consultants are instructed be the Main Contractor	Retained Design Consultants review works to advise the Projet Leader	Clients discover whether the reality is as intended at tender stage
Management Contracts	Client's Design Consultants are invited to accept Contractor design	Coordinating Designer will be a specialist able to deliver the project	Client's Design Consultants shall work through to project close out	Scope of façade specimen testing shall be defined in tender documents	Management Contractor or a Construction Manager package	Managed Works or Trade Contractors complete design to extent of packages	Package and Design Managers report on progress of packages	Contractors and Designers will learn from how the asset is operated
Partnering Contracts	Responsibility for design is assigned to an Integrated Project Team	Client commits to CAPEX with clear specialisation in the Design Team	Design Team consults early with the Partnering Contractor	Project will require façade specimen testing of greatest sophistication	Design Team collaborates with all Partnering Contractors	Quality should be considered for the whole project, and not by package	Procedures are established early to monitor budget and programme	Projects require monitoring in use to provide better OPEX intelligence
What does the Architect do for the project investors?	Someone has to coordinate the whole building and its envelope	Agree to describe building envelope areas as "zones" with performances	Consolidate joint and interface connections to increasing detail	Target tests in the CWCT Standard for systemised building envelopes	Identify joint and interface iterations with disciplined design checks	Verify developed versions of joints and interfaces are fully prescribed	Ensure "as-built" coordinated project information for the enclosure	
	Investors acting as or through the client to consider **Resilience**	Lead Designer for the consultants, who may not be the CDM 2015 "Principal Designer", has a coordinating role in the application for planning approval		Decision to tender on client reviewed contract documentation depending on project Building Contract may postpone design into the construction phase		Construction Leader who is appointed CDM 2015 "Principal Contractor" for all forms of project Building Contract shall obtain building control approval		
Responsible Person (Facility)		Responsible Person (Design) Why not appoint very early in the design phase?				Responsible Person (Build)	Responsible Person (Facility)	
Facilities Manager (Existing)		Cost Consultant						Facilities Manager (New)
Client's appointed natural person as the individual representative Who has that role?			Information Manager (Design)			Information Manager (Build)	Information Manager (Building Manual)	
				Clerk of Works or Compliance Monitor				
				Contract Administrator				
			Construction Leader (PCSA)					
		Planning Consultants		Cladding Specialist (PCSA)				
			BREEAM Assessor					
Consult with the Insurer and the Fire and Rescue Service				Whole Building Airtightness Test Authority (UKAS accredited)				EPC Assessor
				Building Control Authority				

Figure BDM01-8.0.1 *RIBA Plan of Work 2020* and Contracts – RISCAuthority

It matters in the law whether there is an appointed "Responsible Person", or every employer is considered to be that person, or whether an "Accountable Person" is to be appointed earlier than Work Stage 6 on HRBs.

Architects tend not to enjoy "protection of function", where an architect is held responsible and must sign off their building as complete and safe for occupation.

The American Institute of Architects (AIA) was founded in 1857, and the National Council of Architectural Registration Boards (NCARB) in the USA was established in 1919 to license the architectural profession. But licensing is not required in every state, and there appears to be no federal law to require an architect to "sign off" on buildings. That may be a condition of contract, and conventional.

https://centennial.ncarb.org/beginning-of-licensure/

https://www.aia.org/resources/174971-where-we-stand-professional-licensure

The RIBA was founded in 1834. The title "architect" is protected by law in the UK, under Section 20 of the Architects Act 1997, which established the Architects Registration Board (ARB), similar to the US model.

https://www.architecture.com/about/history-charter-and-byelaws

https://www.legislation.gov.uk/ukpga/1997/22/contents

The ARB does not seek to establish the protection of function for architects in the UK beyond public professional registration based on the legal protection of the title "architect". Neither does the RIBA, as Eleanor Jolliffe confirmed in 2019:

"Our current policy is to support continued protection of title for architects as both an assurance to consumers and a benefit to the profession. We don't currently have a policy to actively campaign for protection of function for architects, something we believe any UK government would be highly unlikely to contemplate given UK competition policy."

https://www.bdonline.co.uk/opinion/a-short-history-of-protection-of-title/5101704.article

Architects may accept appointment as "Lead Designer", but that does not mean under contract that they have accepted the functional responsibility to confirm by signature their building is complete and safe for occupation. Liability may be declined in the terms and conditions of professional appointment, and under instruction from Professional Indemnity Insurance providers. The architect of choice may not be up to the task of being the "Lead Designer".

The "Principal Designer" and subsequent "Principal Contractor" roles have distinct legal meaning under the Construction (Design and Management) Regulations 2015. With the Health and Safety Executive (HSE) as the regulator, this is a statutory health and life safety requirement for any substantial building works. BDM01-10.2 considers CDM 2015.

www.hse.gov.uk/construction/cdm/2015/index.htm

The wise investor, acting either as or through the client, will ensure they have a capable natural person taking responsibility for the safety and resilience of building design and construction, at least until the statutory duty holder is formally appointed. Even then the statutory duty holder's responsibility may be limited to health and life safety matters. Consequently, the investor must ensure they have a Resilience Strategy as Principle A.

When the investor is a complex organisation, and the building challenging, it may be wise to focus the role of "client" in a natural person, so that the "Lead Designer" has clear communication. Good buildings are not realised by committee because they are works of art. Yet, their production to a budget on a programme through the design and construction phases requires leadership of a complex division of labour. This tension was the experience of Courtenay Blackmore representing Lloyd's of London, the world's leading insurance and reinsurance marketplace in the development of Lloyd's Building:

Courtenay Blackmore, *The Client's Tale – The role of the client in building buildings*, RIBA Publications, 1990, page 119:

"With the exception of developers, some large companies and central/local authorities, clients are often ignorant of what is involved in procuring a building. Happily, those who have been through the mill are usually very willing to help others and to pass on the lessons they have learned from their own experience. However, not all new clients are fortunate enough to have this help at hand, and have to learn the hard way."

"It is up to the architect and other members of the design team to make the way as easy as possible. They have been through it many times before and have the double duty of doing their own job well, and of also encouraging and helping the client to be fully effective. The first requirement for clients is recognition of their need to learn, followed by a willingness to do so."

Time spent in Work Stage 0 as Principles A and B is never wasted, in choosing the architect even if they are not the "Lead Designer", and in the identification of a natural person to represent "the client" as Principle A.1.

9 A to Z Essential Principles checklist

Satisfaction of the Essential Principles is inevitably a matter of judgement and discretion on each project, but a numbered checklist of actions is provided as a non-exhaustive prompt. In BDM01 2023 there are 300 actions.

Principles	Descriptions	Actions
A	Strategically Assess Resilience	12
B	Engage Insurers Early	15
C	Support Firefighting Operations	26
D	Maximise Non-Combustibility	14
E	Anticipate Arson Attempts	12
F	Monitor Building Services	20
G	Address Occupational Issues	6
H	Extend Structural Stability	9
I	Reduce Fire Severity	26
J	Control Compartment Cavities	9
K	Separate External Openings	10
L	Resist Fire Ingress	5
M	Expect Adverse Weather	9
N	Minimise Consequential Damage	14
O	Facilitate Simple Repair	9
P	Plan Salvage Operations	3
Q	Follow Identified Standards	6
R	Provide Reliable Detection	9
S	Complete Performance Tests	10
T	Procure Quality Materials	11
U	Require Competent Work	8
V	Verify Recorded Information	15
W	Manage Fire Safety	16
X	Action Statutory Assessments	5
Y	Keep Maintenance Commitments	17
Z	Critically Review Experience	4
		300

Figure BDM01-9.0.1 Actions in the *A to Z of Essential Principles* – RISCAuthority

These actions are to be improved over time as statutory and non-statutory guidance is annotated or "tagged" with the *A to Z of Essential Principles*.

The white text on blue box background provides the preferred "tag" in guidance, though with use it will be possible to refer to Letter+Title without description. The annotation of statutory and non-statutory guidance will develop beyond the Letter+Title+Description level into numbered actions in the BDM01-9 checklists.

The BDM01-9 checklist is followed by supporting notes as BDM01-10, arranged thematically to assist with their application to projects. The supporting notes are to be developed as a resource over time. Like the core document of BDM02 2022 they may be separated as a document in the BDM series, reducing BDM01.

9.1 Principle A – Strategically Assess Resilience

Principle A – Strategically Assess Resilience

Assess susceptibility, vulnerability, and recoverability in the structure, construction, and services systems against risks in fire, escape of water, and flooding, to define a strategy for the development project, to be critically reviewed over time.

Essential Principle A will be satisfied by combination of the following actions:

Principle A.1

Investors acting as or through the client decide to invest in a resilient asset

Investors in development, acting either as or through the client, decide to invest in a resilient asset that will be minimally damaged by fire or water, in addition to satisfying legal requirements for the health and life safety of anticipated building occupants, and organise themselves to be represented through a natural person as "the client" to communicate directly with the "Lead Designer", when appointed;

Principle A.2

Client consults early with insurers and the Fire and Rescue Service

Project resilience is assessed by the client at Work Stage 0 in accordance with the RISCAuthority publication *Fire Engineering Guide for Property Protection and Business Resilience 2020*, to include a Business Impact Assessment (BIA), which addresses advice obtained from early consultations with insurers as Principle B and the Fire and Rescue Service as Principle C;

Principle A.3

Assessments of resilience to fire and water damage inform a Project Brief

Assessments of resilience to fire and water damage are prepared by the client into a Project Brief for consultants appointed at Work Stage 1, whether or not the project is considered a "common building situation";

Principle A.4

Briefing documents are developed through design into a Resilience Strategy

Briefing documents are developed through the design phase into a Resilience Strategy, with an appointed "Lead Designer" among consultants planning ahead for Principles D to Y, giving early attention to the advantages of separation between buildings as Principle L and the effect on the later technical design at Work Stage 4, focused on susceptibility, vulnerability, and recoverability in the proposed structure, construction, and building services;

Principle A.5

Client appoints a natural person as their proxy for the statutory duty holder

No later than Work Stage 2, "the client" as Principle A.1 further arranges the appointment of a specialist natural person acceptable to the "Lead Designer" to act as a proxy for the eventual "Responsible Person", as the statutory duty holder legally required to be appointed at handover by the building owner or operator under the Regulatory Reform (Fire Safety) Order 2005;

Principle A.6

Resilience Strategy develops through design into Employer's Requirements

Design development is reviewed for consistency with the Resilience Strategy as BDM01-4 by the client appointed natural persons, to inform a planning application and be incorporated in contract documents before tender of the construction phase. This may be referred to as the Employer's Requirements, and shall include a Movements and Tolerances Report, as Principle H, and a programme that relates to the development discipline of Strategy, Testing, Inspection, Certification, and Compliance (STICC), as Principle S;

Principle A.7

Monitoring by the client's natural person through the construction phase

Provision is made through the construction phase for preferably the same natural person appointed by the client to have a monitoring role, with constant and unrestricted access to the works by arrangement with the contractors, reporting to the client against the contracted Resilience Strategy documents;

Principle A.8

Insurers are informed of non-compliances as Principle B.12

Insurers are kept informed of unresolved non-compliances with the contracted Resilience Strategy documents prior to handover and building occupation, based on the consultations carried out as Principle B.12;

Principle A.9

Fire and Rescue Service is informed of non-compliances as Principle C.22

The Fire and Rescue Service are kept informed of unresolved non-compliances with the contracted Resilience Strategy documents prior to handover and building occupation, based on the consultations carried out as Principle C.22;

Principle A.10

When appointed, the statutory duty holder is informed of non-compliances

When appointed, the "Responsible Person" is kept informed of discussions with insurers and the Fire and Rescue Service about unresolved non-compliances with the contracted Resilience Strategy documents based on resilience assessments prior to handover and building occupation, as Principle V;

Principle A.11

Investors acting as or through the client obtain full disclosure of progress

Investors acting either as or through the client obtain full disclosure of progress towards completing the contract through Strategy, Testing, Inspection, Certification, and Compliance (STICC) as Principle S, highlighting aspects of the building design and construction that fail to satisfy the Employer's Requirements that include but are not limited to Evacuation, Fire, and Resilience Strategies as Principle V.8; and

Principle A.12

Confirmation from the statutory duty holder on health and life safety

Confirmation is received from the "Responsible Person" appointed by the building owner or operator that legal requirements for the health and life safety of building occupants have been satisfied, as Principle V.12, prior to acceptance of handover as Principle V.14.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle A are provided as BDM01-10.1.

9.2 Principle B – Engage Insurers Early

Principle B – Engage Insurers Early

Engage with professional indemnity, construction, defects, building, and contents insurers from the earliest Work Stage in project planning, to interrogate the value of the Essential Principles and optimise the insurability of the building in use.

Essential Principle B will be satisfied by combination of the following actions:

Principle B.1

Insurers have been consulted on project resilience as Principle A.2

Insurers as members of the Association of British Insurers (ABI) are consulted early to help develop a Resilience Strategy as Principle A.2, in parallel with the important establishment of an Evacuation Strategy within a Fire Strategy for universal health and life safety with the Fire and Rescue Service as Principle C.1;

Principle B.2

Consider fire engineering the whole building to BS 7974 *Fire Safety* series

Consultation with the chosen insurers has considered the necessity for a fire engineering approach to the whole building using the BS 7974 Fire Safety series to achieve property protection in addition to health and life safety, to overcome the limitations of statutory guidance and the Building Regulations, starting with a Qualitative Design Review (QDR);

Principle B.3

Adopt BDM02 *Compartmentation and Sprinkler Rules* Version 2 – 2022

Adoption of RISCAuthority publication BDM02 Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules Version 2 – 2022 in the Resilience Strategy as Principle A.4 has been discussed and valued by insurers, in anticipation of Principles H and I;

Principle B.4

Insurers are consulted on external protected zones

Insurers have been consulted on and received full disclosure of the design for horizontal and vertical protected zones of fire resisting construction related to internal compartmentation for the roof as Principle I and the external wall as Principle K, which will influence Principle L;

Principle B.5

Insurers are consulted on combustibility and smoke toxicity

Insurers have been consulted on and received full disclosure of the combustible internal and external construction as Principle D.2, including the combustibility and extent of cavities within compartment walls and floors as Principle J, and concerns of the Fire and Rescue Service about smoke toxicity as Principle C.18;

Principle B.6

Insurers provide guidance to clients on third party schemes as Principle U

Guidance from insurers is provided to the client on recognised third party quality of work schemes for contractors as Principle U, with commitment from the client to tender and contract the works to be undertaken through those schemes in specifications by appointed consultants;

Principle B.7

Duties under Construction (Design and Management) Regulations 2015

Clarification is provided by the client to insurers on how they are preparing to undertake their statutory duties explained in the HSE publication L153 *Managing health and safety in construction – Guidance on Regulations*, under the Construction (Design and Management) Regulations 2015;

Principle B.8

Comply with FPA *Fire Prevention on Construction Sites* 10th Edition: 2022

On construction projects with an original contract value of over £2,500,000 the RISCAuthority, FPA, and Contractors Legal Group (CLG) publication *Fire Prevention on Construction Sites: The Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation* – 10th Edition: August 2022 is complied with in consultation with construction phase insurers;

Principle B.9

Necessity for working at height is either designed out or risk managed

Necessity for working at height is either designed out or risk managed so far as reasonably practicable, particularly when considering roofs and external walls with their geometry of recesses and projections;

Principle B.10

Insurers are invited to witness performance testing as Principle S.9

Insurers are invited to witness performance testing as Principle S.9 and, whether attending or not, receive full disclosure of third party certified test reports and assessments in good time to be able to provide advice to the client;

Principle B.11

Service Life Planning as Principle O with inspection and maintenance

Insurers are advised by the client as to how they ensure all materials, products, and systems that constitute the components that comprise the building are designed, built, and maintained to achieve Service Life Planning as Principle O. This makes inspection possible for statutory assessments as Principle X, and enables the facilities manager to keep maintenance commitments as Principle Y;

Principle B.12

Insurers are informed of non-compliances as Principle A.8

Insurers are informed of unresolved non-compliances with the contracted Resilience Strategy documents as Principle A.8 prior to handover;

Principle B.13

Fire Safety Information and Building Manual on request as Principle V.13

A digital copy of the comprehensive Regulation 38 Fire Safety Information exchange is provided to the "Responsible Person" appointed by the building owner or operator, and the separate CDM 2015 Health and Safety File and Building Manual are provided to the facilities manager appointed by the client as Principle V.13. These digital document exchanges are also provided on request to the insurer at Work Stage 6 handover, without redaction;

Principle B.14

Demonstration that maintenance commitments are kept as Principle Y

Building owners or operators routinely demonstrate to insurers their facilities manager is keeping maintenance commitments as Principle Y; and

Principle B.15

Building owners or operators periodically meet for review as Principle Z

Building owners or operators periodically meet with insurers to critically review their experience of risk managing hazards of fire and water damage recognised in the Resilience Strategy, as Principle Z.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle B are provided as BDM01-10.2.

9.3 Principle C – Support Firefighting Operations

Principle C – Support Firefighting Operations

Consult with the Fire and Rescue Service to facilitate operations in pursuit of life safety with an emphasis on timely self-evacuation, understanding that rescue is a statutory obligation, but protection of the asset requires additional measures.

Essential Principle C will be satisfied by combination of the following actions:

Principle C.1

Evacuation, Fire, and Resilience Strategies for the Fire and Rescue Service

The Fire and Rescue Service has been consulted on project resilience as Principle A.2, in addition to insurers as Principle B.1, beyond the important establishment of an Evacuation Strategy within a Fire Strategy for universal health and life safety;

Principle C.2

Consider fire engineering the whole building to BS 7974 *Fire Safety* series

Consultation with the Fire and Rescue Service has considered the necessity for a fire engineering approach to the whole building, using the BS 7974 *Fire Safety* series to achieve property protection in addition to health and life safety, and to overcome the limitations of statutory guidance and the Building Regulations, starting with a Qualitative Design Review (QDR);

Principle C.3

Adopt BDM02 *Compartmentation and Sprinkler Rules* Version 2 – 2022

Adoption of RISCAuthority publication BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022 in the Resilience Strategy as Principle A.4 has been discussed and encouraged by the Fire and Rescue Service, in anticipation of Principles H and I;

Principle C.4

Fire and Rescue Service is consulted on external protected zones

The Fire and Rescue Service has been consulted on and received full disclosure of the design for horizontal and vertical protected zones of fire resisting construction related to internal compartmentation for the roof as Principle I and the external wall as Principle K, which will influence Principle L;

Principle C.5

Fire and Rescue Service is consulted on combustibility

The Fire and Rescue Service has been consulted on and received full disclosure of combustible internal and external construction as Principle D.2, including the combustibility of cavities within compartment walls and floors as Principle J;

Principle C.6

Salvage is planned with the Fire and Rescue Service as Principle P

Salvage operations are planned with the Fire and Rescue Service in the Fire and Resilience Strategies as Principle P;

Principle C.7

Basements are addressed for means of escape and firefighting operations

Basements are addressed for means of escape in the Evacuation Strategy, with the operational difficulties for the Fire and Rescue Service further addressed in the Fire and Resilience Strategies;

Principle C.8

Storage and Car Parking, with other vehicular access not in BDM02

Storage as Purpose Group 7(a), Car Parking for light vehicles as Purpose Group 7(b), and other parts of the building with vehicular access not addressed by BDM02 are considered as high hazard compartments in the building. They are addressed in the Evacuation Strategy, with operational difficulties for the Fire and Rescue Service further addressed in the Fire and Resilience Strategies;

Principle C.9

Provision of protected escape stairs with evacuation and firefighting lifts

Protected escape stairs and evacuation lifts are addressed in the Evacuation Strategy, with firefighting lifts as an operational provision for the Fire and Rescue Service further addressed in the Fire and Resilience Strategies;

Principle C.10

Provision of protected lobbies to escape stairs with rising mains

Protected lobbies to protected escape stairs are provided with rising mains, whether wet or dry, located in lobbies outside the protected escape stair to prevent trailing fire hoses holding fire doors open, to minimise smoke entering the stairs being used for self-evacuation and rescue in the Evacuation Strategy, and as an operational provision for the Fire and Rescue Service further addressed in the Fire and Resilience Strategies;

Principle C.11

Provision of water mains adjacent to rising mains accessible off the street

Clearly identified water mains adjacent to rising mains, both with valve sets, are provided in an accessible location off the street as an operational provision for the Fire and Rescue Service further addressed in the Fire and Resilience Strategies;

Principle C.12

Provision of sprinkler mains accessible off the street

Where the building is sprinklered as Principle I, preferably to the LPC Sprinkler Rules as BDM02, separate and clearly identified sprinkler mains with valve sets are provided in an accessible location off the street as an operational provision for the Fire and Rescue Service further addressed in the Fire and Resilience Strategies;

Principle C.13

Correction factor for the number of compartments involved at any one time

Before the planning and building control applications, the Fire and Rescue Service have provided a correction factor for the number of compartments they anticipate will be involved at any one time, to be applied to the calculation in Principle L.3 that involves the separation between buildings, in response to the prospect of fire "conflagration", taking account of adverse weather as Principle M.6;

Principle C.14

Necessity for firefighting at height is either designed out or risk managed

Necessity for firefighting at height is either designed out or risk managed, so far as reasonably practicable, particularly when considering roofs and external walls with their geometry of recesses and projections;

Principle C.15

Smoke control to maintain clear escape routes in the Evacuation Strategy

The building layout is considered in relation to the smoke control system discussed as BDM01-10.6, to maintain clear escape routes in the Evacuation Strategy and to assist firefighting operations in the Fire Strategy to the satisfaction of the Fire and Rescue Service, who may prefer "AA" automatic activation rather than the necessity for "MA" manual intervention, for strategies characterised as:

- Natural Opening Smoke Ventilation of escape stairs and corridors
- Mechanical Pressurisation of escape stairs and lobbies
- Natural Smoke and Heat Exhaust Ventilation (N-SHEV)
- Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV);

Principle C.16

Smoke ventilation design anticipates unfortunate high wind pressures

Smoke ventilation system design shall anticipate high wind pressures in unfortunate directions coinciding with worst case patterns of open windows and doors or shattered glazing in the various compartments, as Principle M.7;

Principle C.17

Smoke leakage and toxicity in both construction and contents considered

Smoke ventilation shafts, agreed with the Fire and Rescue Service as Principle C.15 and constructed as Principle D.12 using construction tested for viability as Principle S.7, are tested complete to achieve a Smoke Leakage (S) rate as Principle F.2, integrated with the detection and alarm system as Principles R.2 and R.5, and demonstrated in operation with other smoke control systems as Principle V.2;

Principle C.18

Materials for construction producing toxic smoke are designed out

Materials for construction producing toxic smoke during combustion, harmful to health and life safety as Principle S.8, are designed out, so far as reasonably practicable. This is the companion to but not dependent upon reducing the toxicity of smoke produced from combustible Furniture, Fixtures, and Equipment (FF&E) and contents in a fire event, with Smoke Leakage (S) minimised as Principle I.17, the consequential damage considered as Principle N.1, detection and alarm as Principle R.5, and the health and life safety concerns of the Fire and Rescue Service communicated to insurers as Principle B.5;

Principle C.19

Fire and Rescue Service witnesses performance testing and receives reports

The Fire and Rescue Service is invited to witness performance testing as Principle S.9 and, whether attending or not, receives full disclosure of third party certified test reports and assessments in good time to be able to provide timely advice in consultation, before design development or construction procurement decisions;

Principle C.20

Integrated detection and alarm system for the Evacuation Strategy

The integrated detection and alarm system as Principle R is compatible with and sufficient for the Evacuation Strategy;

Principle C.21

Contingency planning in consultation with the Fire and Rescue Service

Contingency planning in consultation with the Fire and Rescue Service ensures health and life safety is not compromised in the event that active fire protection measures such as sprinkler, smoke control, or detection and alarm systems fail to operate as intended, and is incorporated explicitly into the Evacuation, Fire, and Resilience Strategies;

Principle C.22

Fire and Rescue Service is informed of non-compliances as Principle A.9

The Fire and Rescue Service is informed of unresolved non-compliances with the contracted Resilience Strategy documents as Principle A.9 prior to handover;

Principle C.23

Demonstration that maintenance commitments are kept as Principle Y

Building owners or operators routinely demonstrate to the Fire and Rescue Service their facilities manager is keeping maintenance commitments as Principle Y;

Principle C.24

Building owners or operators periodically meet for review as Principle Z

Building owners or operators periodically meet with the Fire and Rescue Service to critically review their experience of risk managing hazards of fire and water damage recognised in the Resilience Strategy, as Principle Z;

Principle C.25

Fire and Rescue Services Act 2004 and NFCC *National Operational Guidance*

The Fire and Rescue Services Act 2004, particularly Section 7 Firefighting, and the NFCC *National Operational Guidance*, is referred to by clients, building owners or operators when consulting with the Fire and Rescue Service, and substantiated requests for firefighting facilities are satisfied; and

Principle C.26

Measures provide time to extinguish the fire beyond Evacuation Strategy

Considered together, the measures adopted in Principle C provide time beyond the period required for the Evacuation Strategy in which the Fire and Rescue Service has an operational opportunity to extinguish the fire without unacceptable risk to themselves, contributing to the Resilience Strategy as Principle A.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle C are provided as BDM01-10.3.

9.4 Principle D – Maximise Non-Combustibility

Principle D – Maximise Non-Combustibility

Use non-combustible construction materials and products in systems, elements, and spaces, so far as reasonably practicable, as methods of construction that make minimal contribution to fire development and the generation of smoke.

Essential Principle D will be satisfied by combination of the following actions:

Principle D.1

Materials in construction are non-combustible subject to Principle D.2

Materials in all products and systems are non-combustible for internal and external construction, so far as reasonably practicable, defining non-combustible to be Class A1 or Class A2-s1,d0 when tested as Principle S under BS EN 13501-1:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests*, with a smaller quantity of smoke (s1) but no melting droplets (d0) and a gross calorific value threshold of less than 3 MJ/kg for substantial components in the standard, avoiding the National tests in the BS 476 series or transpositions of classes between European and National standards;

Principle D.2

Investors choosing combustible construction with reference to Regulation 7

With the exception of Principles D.4, D.5, D.6, D.9, D.11 and D.12 supporting Principle D.1, and subject to Regulation 7 with statutory guidance giving practical meaning to Schedule 1 Requirements of the Building Regulations 2010, as amended, after considering smoke toxicity in consultation with the Fire and Rescue Service as Principle C.18 based on testing as Principle S.8, investors choosing combustible construction appreciate that the cost of any offer of insurance may increase as insurers estimate potential losses. Which assumes full disclosure by investors to insurers of the technical detail of the constructions involved, whether as separate buildings, or as a portfolio of similar or differentiated assets;

Principle D.3

Discounting fire-resisting internal non-structural joinery products

Contrary to Principle D.1, internal non-structural joinery products are distinguished in the estimation of potential loss, by discounting the fire resisting components, such as fire doorsets, in contrast to accounting for the non-fire resisting components that contribute to the fuel load of combustible construction in a compartmented building, such as built-in cupboards;

Principle D.4

Cavities as Principles I, J and K constructed from non-combustible materials

Cavities as Principles I, J and K, concealed from and inaccessible to the Fire and Rescue Service in a fire situation, are constructed from non-combustible materials as Principle D.1, without admitting combustible materials as Principle D.2;

Principle D.5

Insulated Infill Panels are non-combustible in windows, doors, and vents

Contrary to Principle D.1, external and non-fire resisting windows, doors and vents manufactured to BS EN 14351-1:2006+A2:2016 *Windows and doors. Product standard, performance characteristics. Windows and external pedestrian doorsets* may be combustible, and ignored in the estimation of potential loss, but only when installed in separate wall openings located as Principle D.10, instead of in a series of frames linked as extensive "screens" or "window wall" addressed as Principle D.6. With the exception of any Insulated Infill Panels glazed into rigid frames, which shall be non-combustible as Principle D.1, without incorporating combustible materials as Principle D.2;

Principle D.6

Extensive glazed walls with Insulated Infill Panels are non-combustible

Extensive "screens" or "window wall" assembled from rigid framed windows, doors, and vents that are excluded from Principle D.5, or the "stick" and "unitised" curtain wall systems engineered to accommodate building Movements and Tolerances manufactured to BS EN 13830:2015+A1:2020 *Curtain walling. Product standard*, or the earlier BS EN 13830:2015 still referred to by the Centre for Window and Cladding Technology (CWCT), and the Insulated Infill Panels glazed into them, shall be non-combustible as Principle D.1, all subject to Principle D.9;

Principle D.7

System testing to both Parts of BS 8414 shall not contradict Principle D.1

System testing to both Parts of BS 8414 *Fire performance of external cladding systems*, to the Pass/Fail criteria published by the BRE as BR 135 *Fire performance of external thermal insulation for walls of multistorey buildings*, and extended in application through BS 9414 *Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests*, is not relied upon to contradict BS EN 13501-1 testing as Principle D.1, regardless of Purpose Group and height of building, but while providing no measure of external wall fire resistance may provide supporting evidence to insurers when combustible materials are chosen for the external wall as Principle D.2;

Principle D.8

No reliance made on "desk top studies" as Building Control Alliance TGN 18

No reliance is made on "desk top studies" as Building Control Alliance (BCA) Technical Guidance Note 18 *Use of Combustible Cladding Materials on Buildings Exceeding 18m in Height*, which is not approved by the Secretary of State;

Principle D.9

External walls in protected zones are non-combustible and fire resisting

The external wall in protected zones that separate openings as Principle K, which includes any "backing wall" that supports forms of cladding in layered or "built-up" construction and also glazed walls as Principle D.6, is of non-combustible and fire resisting construction as Principle I.1, and self-supporting in the protected zone, whether part height or full height spanning between compartment floors;

Principle D.10

Openings for products as Principle D.5 are not within the protected zone

Openings for combustible and non-fire resisting windows, doors and vents are not located within the protected zone as Principle K.4, allowing their frames as Principle D.5 to be combustible and non-fire resisting, though they may mechanically retain non-combustible Insulated Infill Panels glazed into them;

Principle D.11

Escape stairs, lobbies, and corridors are non-combustible construction

Escape stairs, lobbies and corridors, which may include protected "refuges" in the absence of a universal Evacuation Strategy, all integrated into the detection and alarm system as Principle R, are constructed from non-combustible materials to improve smoke control as Principle C.15, extending to the final exit to a place of safety outside the building, in addition to Fire and Rescue Service requirements for the use of non-combustible materials in firefighting shafts and other fire safety facilities identified during consultation as Principle C;

Principle D.12

Smoke ventilation shafts as Principle C.17 are internally non-combustible

Smoke ventilation shafts, in either natural or mechanical Smoke and Heat Exhaust Ventilation (SHEV) systems as Principle C.17, are internally constructed entirely of non-combustible materials, designed and built to achieve Smoke Leakage (S) as Principle F.2, discussed as BDM01-10.6;

Principle D.13

Arson attempts are anticipated as Principle E in the design phase

Arson attempts are anticipated as Principle E in the design phase, which may allow the use of combustible materials provided they are in inaccessible locations; and

Principle D.14

Avoid a trade-off between Principles D, N and O in the design phase

Selection of materials addresses the prospects for consequential loss as Principle N, facilitates simple repair as Principle O, and does not force a trade-off between combustibility and repairability that can be avoided in the design phase before construction phase Work Stages.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle D are provided as BDM01-10.4.

9.5 Principle E – Anticipate Arson Attempts

Principle E – Anticipate Arson Attempts

Introduce measures to prevent, so far as reasonably practicable, an anticipated arson attack from an external fire source either thrown or positioned to cause damage anywhere within and around the building, particularly at lower storeys.

Essential Principle E will be satisfied by combination of the following actions:

Principle E.1

Opportunity for climbing the external wall of the building is frustrated

The opportunity for climbing the external wall of the building is frustrated in the design and construction, particularly at balconies or roof terraces, or by concealment of external building services, even to roof areas, as Principle F.4;

Principle E.2

Prioritise non-combustible construction as Principle D.1 at low level

External walls, soffits to projecting or recessed balconies, and eaves or parapets to roof areas, with any external building services including drainage systems, are prioritised at low level to be non-combustible as Principle D.1, where the decision to use combustible external construction is taken as Principle D.2;

Principle E.3

Perimeter security is provided to the site with improved visibility

Perimeter security is provided to the site as a coherent set of measures that are related to improved visibility without obstructions;

Principle E.4

Fuel storage is addressed and protected as a potential target for arson

Fuel storage is addressed as a potential target for arson and protected by security, in addition to compliance with published Building Regulations and statutory guidance for fuel storage for every Purpose Group;

Principle E.5

Permanent external storage controlled by the facilities manager

All permanent external storage is in non-combustible containers located not less than 10m from the building within perimeter security, with the building owner or operator, who may be acting through a facilities manager, taking responsibility for control of combustible materials in storage, whether as equipment, stock, or waste, which includes the use of construction “Skips”, as Principle L.5;

Principle E.6

Temporary external storage controlled by the "Principal Contractor"

All temporary external storage is in non-combustible containers located not less than 10m from the building within perimeter security, with the "Principal Contractor" during the construction phase taking responsibility for control of combustible materials in storage, whether as equipment, stock or waste, which includes the use of construction "Skips";

Principle E.7

Temporary construction works and construction vehicles are secured

Scaffolding, other temporary construction works, and construction vehicles are secured, particularly to prevent climbing;

Principle E.8

Prospects of arson during construction addressed as Principle B.8

Prospects of arson during the construction phase are addressed as Principle B.8;

Principle E.9

Solid waste refuse chutes and storage facilities are secure

Solid waste refuse chutes and storage facilities are secure against arson attempts by those not authorised to use them, so far as reasonably practicable, are managed as Principle W, and are maintained as Principle Y;

Principle E.10

Security in all Purpose Groups not only Dwellings as Purpose Group 1

Security is addressed for all Purpose Groups in addition to compliance with published Building Regulations and statutory guidance for security;

Principle E.11

Locations for anti-burglar or anti-vandal laminated glass

External glazing at ground level or that can be easily reached by climbing has an anti-burglar or anti-vandal laminated glass specification to prevent or at least delay unauthorised access to the building, with secure windows, doors and vents procured by reference to Secured by Design (SBD) guidance for all buildings in every Purpose Group; and

Principle E.12

Security alarms and camera systems are installed and maintained

Security alarms and camera systems are installed and maintained, and are not obscured by temporary works, the growth of perimeter landscaping, or planting on green roofs and walls, requiring maintenance as Principle Y.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle E are provided as BDM01-10.5.

9.6 Principle F – Monitor Building Services

Principle F – Monitor Building Services

Ensure all building services, including local sources of renewable energy or mains utilities connections, are designed, installed, commissioned, and maintained to prevent them being a cause of fire ignition, smoke spread, or water damage.

Essential Principle F will be satisfied by combination of the following actions:

Principle F.1

Building services are specified and procured to support Principles D, I and J

All building services are specified and procured to support Principle D, only penetrating fire resisting construction by installation perpendicular to walls and floors, with independent support both sides, and fire stopped as Principle I, while none of those building services are routed or distributed through any cavities within fire resisting compartment walls and floors as Principle J;

Principle F.2

Smoke ventilation shafts tested to achieve a Smoke Leakage (S) rate

Smoke ventilation shafts as Principle C.17, constructed as Principle D.12 using construction tested for viability as Principle S.7, and completed as part of fire resisting compartmentation as Principle I.17, are tested for smoke tightness, regardless of whether shafts are constructed wholly onsite or constructed offsite and sealed onsite, to achieve a Smoke Leakage (S) rate of:

- <2.0 $m^3/h.m^2$ @ 50 Pa for:
  - Natural Smoke and Heat Exhaust Ventilation (N-SHEV)
  - Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV) with fire resisting ductwork achieving (S) of <5.0 m3/h.m2 @ 500, 1000 or 1500 Pa
- <5.0 $m^3/h.m^2$ @ 500, 1000 or 1500 Pa for:
  - Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV) with the shaft construction only instead of fire resisting ductwork;

Principle F.3

Drainage systems and water mains in separate waterproof service risers

Drainage systems and water mains that may leak are enclosed in separate waterproof service risers to prevent damage to electrical building services and consequential damage to the construction as Principle N;

Principle F.4

External services or drainage through service risers to prevent climbing

Prevent climbing externally as Principle E.1 by designing building services or drainage to be routed or distributed through internal and accessible service risers, without breaching internal compartmentation or the external wall as Principle I;

Principle F.5

Building services are maintained in working order as Principle Y

All building services are monitored throughout their service life, and maintained in working order as Principle Y by contractors operating under a third party quality of work scheme as Principle U to manufacturer's requirements;

Principle F.6

Combustion appliances and fuel storage comply with Building Regulations

Combustion appliances and fuel storage systems are compliant with Building Regulations and statutory guidance for combustion appliances and fuel storage systems, whether solid, liquid or gas fuel systems, with particular attention given to external storage and site security as Principle E.5;

Principle F.7

Gas services avoiding protected escape routes in ventilated service risers

Gas mains, meters, and service supply pipes are not located within a protected stairway or escape corridor, and are contained within dedicated locked and ventilated service riser compartments, separate from electrical services;

Principle F.8

Gas main isolation valves agreed with the Fire and Rescue Service

Gas main isolation valves are agreed in their specification and location through consultation with the Fire and Rescue Service as Principle C;

Principle F.9

Hydrogen technologies require specialist guidance in the Resilience Strategy

Specialist guidance is written into the Resilience Strategy as Principle A and maintenance commitments as Principle Y for hydrogen technologies, either as gas combustion appliances or as fuel cells generating electricity from gas;

Principle F.10

Electrical services and meters in risers are separate from gas services

Electrical services and meters are separate from gas services and meters, and are contained within a dedicated locked service riser compartment;

Principle F.11

Electrical installations comply with the Building Regulations

Electrical mains, meters, circuit breakers, and cabled installations to small power sockets and lighting are compliant with Building Regulations and statutory guidance for electrical safety;

Principle F.12

Electricity generation requires specialist guidance in the Resilience Strategy

Specialist guidance is written into the Resilience Strategy as Principle A and maintenance commitments as Principle Y for onsite electricity generating technologies such as roof mounted wind turbines and photovoltaic (PV) panels, or Building Integrated Photovoltaic (BIPV) panels, with any lithium-ion battery storage facilities within the building;

Principle F.13

Electrical main isolation switches agreed with the Fire and Rescue Service

Electrical main isolation switches are agreed in their specification and location through consultation with the Fire and Rescue Service as Principle C;

Principle F.14

Emergency lighting, illuminated fire signage, and Fire Control Panels

Emergency lighting and illuminated fire signage is installed, and independent emergency power supplies provided to Fire Control Panels (FCPs), preferably in dedicated rooms, fully integrated with the detection and alarm system as Principle R, agreed through consultation with the Fire and Rescue Service as Principle C;

Principle F.15

Hot water services require specialist guidance in the Resilience Strategy

Specialist guidance is written into the Resilience Strategy as Principle A and maintenance commitments as Principle Y for ground source heat pumps, roof mounted solar water heaters, or hot water storage systems that are not addressed in Building Regulations and statutory guidance for sanitation, hot water safety, and water efficiency;

Principle F.16

Fire door hold-open or free-swing devices operate on first smoke detection

Permanent or fusible link hold-open devices are not installed on fire doors in any instance, and where electromagnetic hold-open or free-swing devices are installed on fire doors they operate on first smoke detection, as agreed with the Fire and Rescue Service as Principle C;

Principle F.17

Smoke systems, fire curtains, fire shutters, and closing devices maintained

Any installed Automated Opening Vent (AOV), fans and dampers in the smoke control system, fire curtains, fire shutters, and any automated closing devices as agreed with the Fire and Rescue Service as Principle C are a focus of fire safety management as Principle W, and maintained as Principle Y;

Principle F.18

Protection against lightning strike as Principle M.8 protects building services

Protection is provided against lightning strike as Principle M.8 to protect the building services in addition to the structure and construction;

Principle F.19

Building services are verified through recorded information as Principle V

The integrated building services addressed in the Resilience Strategy are specified and contracted to ensure third party certified products as Principle T are installed to a third party quality of work scheme as Principle U, so that at commissioning before handover, the Building Manual for the building services is verified through recorded information as Principle V by the client's facilities managers; and

Principle F.20

Moveable heating and ventilation appliances are unnecessary or managed

Moveable heating and ventilation appliances are made unnecessary by the design of the integrated building services, so far as reasonably practicable, or where necessary are controlled by facilities managers as Principles W.8 and X.4.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle F are provided as BDM01-10.6.

9.7 Principle G – Address Occupational Issues

Principle G – Address Occupational Issues

Address the design, construction, management, and rearrangement of the building to specific hazards and risks facing occupants as "Relevant Persons", occupying either a building in an identified purpose group or a mixed-use facility.

Essential Principle G will be satisfied by combination of the following actions:

Principle G.1

Evacuation and Fire Strategies consider occupants as "Relevant Persons"

The project Evacuation Strategy within the Fire Strategy as Principle C considers the present or future occupants of the building, and the contribution they will be making to health and life safety as "Relevant Persons", supported by the facilities manager appointed or anticipated by the building owner or operator;

Principle G.2

Resilience Strategy further considers occupants as "Relevant Persons"

The project Resilience Strategy as Principle A, agreed with the insurer as Principle B, considers the present or future occupants of the building, and the contribution they will be making to resilience as "Relevant Persons", supported by the facilities manager appointed or anticipated by the building owner or operator;

Principle G.3

Purpose Groups in core document BDM02 are considered for the occupancy

Purpose Groups in core document BDM02 are referred to as the broad categorisation when considering present or future occupants of the building, with narrower categories of occupational use or interacting groups of users defined in project Strategies, so far as reasonably practicable;

Principle G.4

Combustible contents as occupational fire load in the Resilience Strategy

Combustible contents are described and defined as an occupational fire load expected for the occupational use as Principle G.3, to provide design assumptions to be recognised in the Resilience Strategy, to inform choices in sprinkler protection and compartment size as Principle I, and managed as Principle W;

Principle G.5

Material change of use shall be considered in consultation with insurers

Any material change of use shall be considered in consultation with insurers as Principle B, approved by the local planning authority where not a permitted development right, and notified to the building control inspector as Regulation 5 of the Building Regulations 2010; and

Principle G.6

Building owners or operators periodically meet with insurers as Principle Z

Building owners or operators periodically meet with insurers to critically review their experience of risk managing hazards of fire and water damage recognised in the Resilience Strategy, providing insight on occupational issues ranging from individual behaviour to changing sociological factors, as Principle Z.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle G are provided as BDM01-10.7.

9.8 Principle H – Extend Structural Stability

Principle H – Extend Structural Stability

Engineer against structural collapse and excessive deflection within compartment walls and floors, to accommodate all imposed loads in fire situations, beyond the statutory life safety requirement and risk of accidental disproportionate collapse.

Essential Principle H will be satisfied if the primary structure of the building has been engineered and constructed by combination of the following actions:

Principle H.1

Prevent partial structural collapse for an extended period of time

Prevent partial structural collapse for an extended period of time, classified as fire resistance Stability (R) to BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*, additional to that required by the Fire and Rescue Service to search for and rescue occupants throughout the building as an operational priority in the Evacuation Strategy as Principle C, providing time to fight the fire in the Resilience Strategy as Principle A, and agreed by the client after reviewing compartment fire resistance periods as Principle I.4;

Principle H.2

Accommodate all imposed loads in the expected non-fire and fire situations

Accommodate all imposed loads in the expected non-fire and fire situations, taking account of all stages of fire development under changing conditions of ventilation, which may coincide with adverse weather as Principle M;

Principle H.3

Consider the building as an entity and in the structure of compartments

Consider the building both as an entity and in the structure of compartments, with particular attention to the introduction of cavities in primary structure that are inaccessible within compartmentation as Principle J;

Principle H.4

Prevent collapse of the primary roof structure in the protected zone

Prevent collapse of the primary roof structure as Principle H.1, regardless of roof collapse being accepted in some circumstances in statutory guidance if not a risk to health and life safety, when extended fire resistance in a protected zone of the roof as Principle I.5 is included in the Resilience Strategy as Principle A;

Principle H.5

Minimise movements by limiting deflections in expected non-fire situations

Minimise movements by limiting deflections in expected non-fire situations, which include extreme cases during the construction phase in crane lifting that are not present post-construction, or posed by a travelling Building Maintenance Unit (BMU) required as Principle Y, and additionally in the expected fire situations;

Principle H.6

Define tolerances through iterations of a Movements and Tolerances Report

Define tolerances for the construction that are related to minimised movements in the structure through iterations of a Movements and Tolerances Report to be included in contract documents, which may require performance testing as Principle S, with verification provided to the client in surveys undertaken by the contractor throughout the construction phase before handover as Principle V;

Principle H.7

Remove the risk of accidental disproportionate collapse of primary structure

Remove the risk of accidental disproportionate collapse of the building primary structure in horizontally or vertically adjacent structural bays that may cause damage to compartmentation as Principle I.1;

Principle H.8

Protect from consequential damage, facilitate simple repair and plan salvage

Consider how primary structure may be protected from consequential damage as Principle N, simply repaired as Principle O, and plan how structure will be partially salvaged as Principle P after fire or water damage, integrating that thinking into the Resilience Strategy; and

Principle H.9

Specify any maintenance required by the primary structure as Principle Y

Specify any maintenance required by the primary structure as Principle Y, ensuring the maintained primary structure remains accessible.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle H are provided as BDM01-10.8.

9.9 Principle I – Reduce Fire Severity

Principle I – Reduce Fire Severity

Compartmentalise and fully protect the building with a sprinkler system so that if a fire starts, the extent of fire, heat, and smoke damage should be minimised and confined in the compartment of origin, so far as reasonably practicable.

Essential Principle I will be satisfied by combination of the following actions:

Principle I.1

Compartmentation with enhanced fire resisting construction as BDM02

The building is compartmented with fire resisting construction for passive fire protection by Purpose Group as BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022, using classifications to BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*, with or without sprinklers as Principle I.2. The purpose of enhanced compartmentation is to achieve a complete burn-out of the contents of the compartment, recognising that the Fire and Rescue Service need to intervene to confirm extinguishment before the fire event can eventually be considered over. Any flaming or smouldering combustion in combustible primary structure as Principle H, compartmentation as Principle D, and cavities as Principle J, shall be confirmed extinguished. The compartments are to be constructed without loss of fire resistance at flues, shafts, and building service risers built into walls or through floors, and at openings, interfaces, joints, and building services penetrations, with classification for Smoke Leakage (S) as Principle I.17;

Principle I.2

Sprinkler protected to the LPC Sprinkler Rules 2015 and Technical Bulletins

When active fire protection in the Resilience Strategy as Principle A is chosen to augment Principle I.1, the building is sprinkler protected with one of the two valued options in the *LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance*, updated by the series of RISCAuthority Technical Bulletins, which if procured as Principle T, installed as Principle U, verified as Principle V, managed as Principle W, and maintained as Principle Y.12, reduces the contribution to fire development of combustible construction as Principle D and combustible contents as Principle G;

Principle I.3

Alternative suppression agreed with insurers and Fire and Rescue Service

Contrary to Principle I.2, when options in the LPC Sprinkler Rules are disregarded as active fire protection, because the expected fire will not be suppressed by sprinklers or because valuable contents will be damaged by sprinklers, an alternative suppression system is agreed with insurers as Principle B and the Fire and Rescue Service as Principle C, procured as Principle T, installed as Principle U, verified as Principle V, managed as Principle W, and maintained as Principle Y;

Principle I.4

Enhancements to Stability (R) for the primary structure as Principle H.1

The primary structure as BDM02-3.1 is enhanced for Stability (R) as Principle H.1 beyond the compartment fire resistance Stability (R), Integrity (E), and Insulation (I) or combined (REI) as Principle I.1;

Principle I.5

Protected zones aligned in roofs and external walls, supported by structure

Compartment walls as BDM02-3.3 are covered on both sides with a protected zone of fire resisting construction in the roof as BDM02-3.2, aligning as Principle K.1 with the protected zone in the external walls as BDM02-3.4, as Principles I.6 to I.11, and supported by primary roof structure as Principle H.4;

Principle I.6

Fire resistance of protected and unprotected zones in roofs with openings

The protected zones of the roof as Principle I.5 are non-combustible construction as Principle D and have the same fire resistance (REI) as the internal compartment walls, including the gutters recessed into or upstands projecting from the roof in the protected zone, while the remainder of the roof has a minimal fire resistance of 30(EI) in which openings for roof lights, hatches or vents are unprotected;

Principle I.7

Dimension protected zones in roofs with allowances for projections

The dimensions of the fire resisting protected zones in the roof as Principle I.5 are agreed in consultation with the insurer as Principle B, with allowances for any fire resistant and weathered projections of the compartment walls above the roof;

Principle I.8

Openings in the roof not located within protected zones unless fire resisting

Openings for roof lights, hatches and vents are not located within the protected zone of the roof unless those products have been tested to achieve an equivalent non-combustibility and fire resistance, and where openable have been automated to mechanically close in the event of smoke detection in the building;

Principle I.9

Roof mounted plant and building services supported in the roof zones

Roof mounted plant and associated building services are supported by structure and construction with an equivalent non-combustibility and fire resistance to the protected or unprotected zones in which they are located, are designed to safely collapse earlier in the unprotected zone without affecting the protected zone, and do not compromise the compartmentation as Principle I.1;

Principle I.10

Interfaces with fire stopping between roofs and internal compartment walls

Installed fire stopping at interfaces between the roof and internal compartment walls is tested to the same fire resistance Integrity (E) and Insulation (I) as the internal compartment walls as Principle I.1, to control the transfer of heat, and prevent the passage of hot and cold smoke;

Principle I.11

Alignment of cavity barriers with internal compartment walls and openings

Installed cavity barriers within cavity roof construction, aligned with internal compartment walls, at closer intervals in extensive cavities, and around openings for roof lights, hatches and vents, are tested to the same fire resistance Integrity (E) and Insulation (I) as the roof in the protected zone or the remaining minimum 30(EI) zone, to control the transfer of heat, and prevent the passage of hot and cold smoke;

Principle I.12

Inaccessible cavities within compartment walls and floors are risk managed

Inaccessible cavities within internal compartment wall construction as BDM02-3.3 and within compartment floors as BDM02-3.5 are risk managed, do not contain sources of ignition or unnecessary fuel load, are denied as a distribution route for building services as Principle F, and addressed as Principle J;

Principle I.13

Protected zones in external walls considering cavity barriers or fire stopping

External walls with attachments as BDM02-3.5 considered for combustibility as Principle D, whether with cavities denied as a distribution route for building services as Principle F, requiring cavity barriers, or requiring fire stopping at compartment wall and floor edges, are considered as fire resisting protected zones in relation to unprotected openings as Principle K. Recognising the lack of a single compartment floor or wall line, when internal cavities are present as Principle J;

Principle I.14

Penetrations through compartment walls and floors are fire stopped

Penetrations through compartment walls and floors for building services are coordinated in location as Principle F, are kept few in number and not over-sized, so far as reasonably practicable, and are fire stopped to reinstate compartmentation as Principle I.1, to control the transfer of heat and prevent the passage of hot and cold smoke;

Principle I.15

Cavities from finishing construction internal to compartment accommodation

Cavities hidden from sight behind finishing construction internal to compartmented accommodation, such as raised floors, wall linings and suspended ceilings, or above ceilings below a roof, are not extended to breach compartmentation, but are divided in their extent within compartments by cavity barriers, with fire resistance maintained at building service penetrations through cavity barriers when used as a distribution route, as Principle F;

Principle I.16

Smoke control systems consider cavities from finishing construction

Smoke control systems, whether natural or mechanical, consider the presence of cavities below raised floors, behind wall linings, and above suspended ceilings in relation to compartment walls and floors as Principle I.1, which control the transfer of heat, and prevent the passage of hot and cold smoke;

Principle I.17

Compartment walls and floors are Smoke Leakage (S) rated construction

In addition to the smoke ventilation shafts as Principle F.2, other fire resisting compartmentation as Principle I.1 is designed and built after viability testing as Principle S.7 to achieve a Smoke Leakage (S) rate of <2.0 $m^3/h.m^2$ @ 50 Pa, to improve health and life safety and minimise consequential smoke damage, which should include but is not limited to compartmentation for:

- Natural Opening Smoke Ventilation of escape stairs and corridors
- Mechanical Pressurisation of escape stairs and lobbies
- Firefighting shafts and other fire safety facilities
- Service Risers;

Principle I.18

Accessible openings through compartmentation to maintain fire resistance

Openings made through compartment walls and floors for access are coordinated in design to allow reinstatement of the compartmentation, are kept few in number and not over-sized, so far as reasonably practicable, enable Principles I.19, I.20, I.22 and I.23 to be achieved, and maintain fire resistance at fire tested interfaces to control the transfer of heat and prevent the passage of hot and cold smoke;

Principle I.19

Horizontal fire hatches and fire shutters (EIS) rated equal to floors

All horizontal fire hatches and fire shutters have a fire resistance for Integrity (E) and Insulation (I) equal to the compartment floors they provide access through, as Principle I.1, and are Smoke Leakage (S) rated to prevent the passage of hot and cold smoke;

Principle I.20

Vertical fire curtains, fire shutters, and fire doors (EIS) rated equal to walls

All vertical fire curtains, fire shutters and fire doors, regardless of whether they are constructed as doors in frames or doorsets, have a fire resistance for Integrity (E) and Insulation (I) equal to the compartment walls they provide access through, as Principle I.1, and are Smoke Leakage (S) rated to prevent the passage of hot and cold smoke;

Principle I.21

Fitting of self-closing devices on fire doors without exception

Without exception, fire doors in frames and doorsets other than those installed for access to building services as Principle I.23 are fitted with self-closing devices, which may be augmented with hold-open devices, and include free-swing door closers or other innovations in ironmongery fittings for convenient self-closing that activate as part of the detection and alarm system as Principle R;

Principle I.22

Glazing in compartment walls and floors of equivalent fire resistance

Glazing in compartment wall and floor construction, including glazing to fire doors in frames and doorsets, is tested and classified for Integrity (E) and Insulation (I) to provide a fire resistance equivalent to the compartment, as Principle I.1;

Principle I.23

Access panels in compartment walls and floors of equivalent fire resistance

Access panels to compartments for building services distribution, often arranged vertically as service risers, have fire resistance equal to the construction they provide access through, as Principle I.1, and are Smoke Leakage (S) rated to prevent the passage of hot and cold smoke, whether they are small panels or constructed as doors in frames or doorsets;

Principle I.24

Building services access kept locked and checked by facilities managers

All building services access panels as Principle I.23 are kept locked when not in use and checked by the facilities manager as an aspect of fire safety management, with keys formally issued to and returned by fire risk assessors as Principle X and maintenance operatives instructed as Principle Y;

Principle I.25

Roof spaces provide no horizontal distribution for building services

Cavities within any roof spaces provide no distribution route along the cavity for building services as Principle F, with service penetrations vertically through the roof fire stopped and detailed to control the transfer of heat and prevent the passage of hot and cold smoke; and

Principle I.26

Fire resisting construction is tested, installed, checked, and maintained

Fire resisting construction is fire tested as third party certified products or systems as Principle T, installed to a third party quality of work scheme as Principle U, checked by management as Principle W, and maintained as Principle Y.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle I are provided as BDM01-10.9.

9.10 Principle J – Control Compartment Cavities

Principle J – Control Compartment Cavities

Design out cavities within the internal compartment walls and floors, so far as reasonably practicable, and where cavities are necessary, provide cavity barriers or fire stopping to prevent extensive routes for flame, heat, and hot or cold smoke.

Essential Principle J will be satisfied by combination of the following actions:

Principle J.1

Design out cavities or construct to be "fire sterile" and limited in extent

Cavities have either been designed out by adopting solid construction, or, where present, constructed to be "fire sterile" and limited in extent, as cavities that contain no volume of combustible materials as Principle D, provide no distribution route for building services as Principle F, and are fire stopped to prevent extensive routes for flame, heat, and the passage of hot and cold smoke;

Principle J.2

Intumescent materials to prevent the passage of flame, heat, and smoke

Intumescent materials are not used if they may fail to activate immediately to prevent the passage of flame, heat, and hot or cold smoke;

Principle J.3

Cavities within internal compartment walls and floors as a risk in CDM 2015

Cavities within internal compartment walls and floors have been scheduled, drawn or modelled by the "Lead Designer" for the client and their "Principal Designer" to understand, and in reference to the Movements and Tolerances Report resolved as technically detailed construction to satisfy Building Regulations, which in England is Requirement B3(4) in Schedule 1 of the Building Regulations 2010, as BDM01-11, for inclusion in the CDM 2015 Health and Safety File provided to the "Principal Contractor" at tender for contract;

Principle J.4

Linear joint fire stopping tested to BS EN 1366-4 and checked in application

Linear joint fire stopping is tested to BS EN 1366-4:2021 *Fire resistance tests for service installations. Linear joint seals*, with the static non-combustible substrate of the furnace test further considered when applied to the substrate of construction subject to the Movements and Tolerances Report;

Principle J.5

Fire stopping has the same fire resistance as the compartment wall and floor

Fire stopping has the same fire resistance Integrity (E) and Insulation (I) as the compartment wall and floor from one side to the other, when walls and floors are comprised of a pair of constructions forming an element around a cavity;

Principle J.6

Compartment wall and floor elements are fire stopped at their perimeters

Compartment wall and floor elements are fire stopped at their perimeters where they interface with either solid or cavity construction elements to ensure cavities do not interconnect, and around all openings or penetrations;

Principle J.7

Extensive cavities in long, high or labyrinthine elements are controlled

Extensive cavities in long, high or labyrinthine elements are controlled with linear joint fire stopping at no more than 6.0m apart in plan or elevation, at every compartment wall or floor line, and at every change in orientation, whichever is the lesser interval. In some Modern Methods of Construction (MMC) this is an onerous consideration, requiring rigorous site supervision to consistently control critical details in cavity construction, as Principles S, T, and U;

Principle J.8

Installation of fire stopping as tested is photographed as Principle V

Installation of every interfacing line of fire stopping as tested to Principle J.4 is digitally photographed, collated, and numbered to the logical arrangement as Principle J.3 by the "Principal Contractor" to demonstrate their action on the CDM 2015 Health and Safety File, and provided in entirety in support of the Regulation 38 Fire Safety Information exchange at handover, as Principle V; and

Principle J.9

Service life of the fire stopping requiring no maintenance after installation

The service life of the fire stopping is no less than the service life of the element containing it, requiring no maintenance after installation, as Principle Y.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle J are provided as BDM01-10.10.

9.11 Principle K – Separate External Openings

Principle K – Separate External Openings

Slow the speed of external fire growth beyond the compartment of origin within external walls and soffits, separating openings with fire resisting construction, including attachments such as balconies, so far as reasonably practicable.

Essential Principle K will be satisfied by combination of the following actions:

Principle K.1

Protected zones at compartment walls and floors aligned as Principle I.5

Compartmentation as Principle I.1 includes fire resisting construction in external walls as BDM02-3.4, with a vertical protected zone on both sides of the internal compartment walls as BDM02-3.3, aligning as Principle I.5 with the protected zone in the roof as BDM02-3.2, supported as Principle H.4, and with a horizontal protected zone at compartment floors as BDM02-3.5, as Principles K.2 to K.7;

Principle K.2

External wall protected zones are non-combustible and fire resisting

The protected zones of the external wall as Principle K.1 are non-combustible construction as Principle D, and have the same fire resistance (REI) as the internal compartment walls and floors, to include any balconies or soffits recessed into or projecting from the external wall in the protected zone, while the remainder of the external wall has a minimal fire resistance of 30(EI) in which openings for windows, doors or vents are unprotected;

Principle K.3

Dimension protected zones in external walls with allowances for projections

The horizontal and vertical dimensions of the fire resisting protected zones in the external wall as Principle K.1 are agreed in consultation with the insurer as Principle B, with allowances for any attachments such as balconies providing fire resistant projections beyond the face of the external wall, with early discussion about architectural fenestration to practically resolve Principle K.4. As a suggested default vertically, the protected zone in the external wall should be a minimum of 900mm across the internal compartment floor. This may be reduced only when a minimum 600mm fire resisting horizontal projection is provided where an opening is lowered to finished floor level or raised to the soffit of the compartment floor;

Principle K.4

Openings in the wall not located within protected zones unless fire resisting

Openings for windows, doors, and vents as Principle D.10 are not located within the protected zone of the external wall as Principle K.3, to avoid products as Principle D.5 being additionally tested to achieve an equivalent non-combustibility and fire resistance to the protected zone, including their vision glazing, or where openable being automated to mechanically close in the event of smoke detection;

Principle K.5

Wall mounted plant and building services supported in the wall zones

External wall mounted plant and associated building services are supported by structure and construction with an equivalent non-combustibility and fire resistance to the protected zone and compartment walls or floors;

Principle K.6

Interfaces with fire stopping between walls and internal compartment walls

Installed fire stopping at interfaces between the external walls and internal compartment walls and floors is tested to the same fire resistance Integrity (E) and Insulation (I) as the internal compartment walls and floors as Principle I.1, to control the transfer of heat and prevent the passage of hot and cold smoke;

Principle K.7

Alignment of cavity barriers with internal compartment walls and openings

Installed cavity barriers within external cavity wall construction, installed to align with internal compartment walls, at closer intervals in extensive cavities, and around openings for windows, doors, and vents, are tested to the same fire resistance Integrity (E) and Insulation (I) as the external wall in the protected zone or the remaining minimum 30(EI) zone, to control the transfer of heat and prevent the passage of hot and cold smoke;

Principle K.8

Cavities in external walls provide no distribution route for building services

Cavities within the external wall construction provide no distribution route along the cavity for building services as Principle F, with service penetrations horizontally through and perpendicular to the external wall fire stopped and detailed to control the transfer of heat and prevent the passage of hot and cold smoke;

Principle K.9

Linear joint fire stopping tested to BS EN 1366-4 and checked in application

Linear joint fire stopping is tested to BS EN 1366-4:2021 *Fire resistance tests for service installations. Linear joint seals*, with the static non-combustible substrate of the furnace test further considered when applied to the substrate of construction subject to the Movements and Tolerances Report; and

Principle K.10

Fire resisting construction is tested, installed, checked, and maintained

Components have been fire tested as third party certified products or systems as Principle T, are installed to a third party quality of work scheme as Principle U, are checked by management as Principle W, and are maintained as Principle Y.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle K are provided as BDM01-10.11.

9.12 Principle L – Resist Fire Ingress

Principle L – Resist Fire Ingress

Resist external fire ingress into the premises by party wall separation from any adjoining building, sterilisation of roofs, and control of external fire resistance with distance between neighbouring buildings, so far as reasonably practicable.

Essential Principle L will be satisfied by combination of the following actions:

Principle L.1

Adjoining buildings separated by compartment walls with protected zones

Adjoining buildings are separated by party walls considered as compartment walls as Principle I.1, with fire resistance for the Purpose Group from each side, roof construction with a protected zone as Principle H.4, protected zones in the external wall as Principle K, and aligned as Principle I.5;

Principle L.2

Roofs to resist ignition by radiation and "burning brands" carried in the wind

Roofs with non-combustible and combustible materials in layers as Principle D and fire resistant protected zones as Principle I are additionally capable of resisting ignition by radiation and "burning brands" carried in the wind from neighbouring fires, by being tested and classified BROOF(t4) to BS EN 13501-5:2016 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests*, avoiding National tests in the BS 476 series, or transpositions between European and National classifications;

Principle L.3

Calculate percentage of non-fire resistant unprotected area in external walls

Without abandoning Principle K for protected zones, calculations of the percentage of non-fire resistant unprotected area in the external walls, based on BRE BR 187 *External fire spread: building separation and boundary distances* - Second Edition, are submitted in the building control application to address the issue of heat radiation between buildings. In England this is an aspect of Requirement B4(1) in Schedule 1 of the Building Regulations 2010, as BDM01-11. Correcting calculations in BRE BR 187 for the maximum number of compartments the Fire and Rescue Service anticipates will be involved at any one time as Principle C.13, and taking account of adverse weather as Principle M.6;

Principle L.4

Green roofs and walls considered as a variable ignitable external fuel load

Intensively or extensively planted green roofs and walls involving growing medium and living plants of variable water content are considered as an ignitable external fuel load as Principle D, subject to adverse weather as Principle M.9, managed as Principle W.5 and W.6, assessed as Principle X, and maintained as Principle Y; and

Principle L.5

Permanent external storage controlled by the facilities manager

All permanent external storage is in non-combustible locked containers located at least 10m from the building within perimeter security, with the building owner or operator, who may be acting through a facilities manager, taking responsibility for control of combustible materials in storage, whether as equipment, stock, or waste, which includes the use of waste "Skips", in anticipation of accidental fires and against the prospect of deliberate fire starting as Principle E.5 for arson.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle L are provided as BDM01-10.12.

9.13 Principle M – Expect Adverse Weather

Principle M – Expect Adverse Weather

Protect the building envelope against degradation from incident solar radiation, wind, and water, interrelated to thermal cycles, anticipating prospects of flooding, high rainfall, drought, and high wind, which may also complicate the event of fire.

Essential Principle M will be satisfied by combination of the following actions:

Principle M.1

Weathertight building envelope protects the construction from degradation

Construction of roofs and external walls with attachments provides a weathertight building envelope protecting construction materials, products, and systems from degradation over time by solar radiation, wind, water, and thermal cycles;

Principle M.2

No degradable construction with fire performance exposed to the weather

No degradable materials, products, and systems required for their fire performance are designed to be exposed to the weather;

Principle M.3

Degradable construction is specified and procured as Principle T

Materials in products and systems that are degraded in performance classifications for combustibility and fire resistance, which may be caused by their wetting and drying, freezing and thawing, heating and cooling, expansion and contraction, or by the movements of substrates to which they are fixed or abut, are specified and procured for construction as Principle T;

Principle M.4

Drainage of roofing, terraces, and balconies is designed for high rainfall

Drainage for areas of roofing, terraces, and balconies is sized and backed with overflow details to ensure high rainfall does not overload either gravity or syphonic systems, to prevent discharge of rainwater onto or into degradable construction, providing access for drainage to be maintained as Principle Y;

Principle M.5

Fixings tested, designed, and installed in the expectation of high wind loads

Fixings of materials, products, and systems are tested, designed, and installed to specialist guidance in the expectation of high wind loads, with fixings specified to identified standards as Principle Q, tested as Principle S, procured for construction as Principle T, fixed as Principle U, and maintained as Principle Y;

Principle M.6

Adverse weather is accounted for in the correction factor as Principle C.13

Adverse weather and particularly high winds in unfortunate directions has been accounted for in the correction factor as Principle C.13, for the number of compartments the Fire and Rescue Service anticipates will be involved at any one time, applied to the calculation in Principle L.3;

Principle M.7

Computational Fluid Dynamics studies of the smoke control system

Computational Fluid Dynamics (CFD) studies of the smoke ventilation system, undertaken to satisfy the Fire and Rescue Service as Principle C.16, shall anticipate high wind pressures and unfortunate directions coinciding with worst case patterns of open windows and doors, or shattered glazing;

Principle M.8

Protection is provided against lightning strike on the building as RC35

Protection is provided against lightning strike on the building in accordance with RISCAuthority RC35 *Protection of Buildings against lightning strike*, tested as Principle S, verified as Principle V, and maintained as Principle Y; and

Principle M.9

Green roofs and walls are constantly irrigated and maintained as Principle Y

Intensively or extensively planted green roofs and walls involving growing medium and living plants are constantly irrigated for healthy growth through low and high temperature conditions, when freezing or drying is exacerbated by high winds, and particularly during periods of drought, to be managed as Principle W.5 and W.6, assessed as Principle X, and maintained as Principle Y.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle M are provided as BDM01-10.13.

9.14 Principle N – Minimise Consequential Damage

Principle N – Minimise Consequential Damage

Invest in measures to limit the extent of damage caused by heat, smoke, and water in the event of fire, and by escape of water incidents, ensuring assets and the environment are minimally affected, so far as reasonably practicable.

Essential Principle N will be satisfied by combination of the following actions:

Principle N.1

Design out materials that generate toxic smoke or melt to spread fire down

Materials in products and systems that give off large quantities of toxic smoke, or melt to spread fire downwards and into pool fires in a fire situation, are designed out as Principle D.1, in preference to combustible materials as Principle D.2, consulting with the Fire and Rescue Service as Principle C.18;

Principle N.2

Design out porous materials damaged by the absorption of water or freezing

Porous materials in products and systems damaged by the absorption of water are designed out of construction where they may be exposed to water from leaks, ground moisture, wind-driven rain, surface or interstitial condensation, and with particular attention to the selection of thermal insulations;

Principle N.3

Waterproofing to capture and manage water from active systems or leaks

Waterproofing to capture and manage water from activated sprinkler or other suppression systems, or non-activated system leaks, is installed in each compartment, so far as reasonably practicable;

Principle N.4

Isolate wet piped systems in unoccupied buildings unless part of resilience

Wet piped systems are isolated when the building is unoccupied, unless they are part of the Resilience Strategy, such as suppression systems or rising mains;

Principle N.5

In-service wet piped systems are isolated by readily identifiable means

When in service, it is possible to easily isolate wet piped systems by means that are readily identifiable, easily accessible at low level to facilities managers at all times, secured for facilities managers, and maintained as Principle Y;

Principle N.6

Sprinkler system pressure is in accordance with the LPC Sprinkler Rules

Sprinkler system pressure is in accordance with the LPC Sprinkler Rules as Principle I.2, tested as Principle S, verified at handover as Principle V, checked for leaks and maintained as Principle Y.12;

Principle N.7

Pressure of all water systems other than sprinkler systems limited to 3.0 bar

Pressure of all water systems other than sprinkler systems as Principle N.6 is limited to 3.0 bar, tested as Principle S, verified at handover as Principle V, checked for leaks and maintained as Principle Y.13;

Principle N.8

Drainage systems and water mains in separate waterproof service risers

Drainage systems and water mains that may leak are enclosed in separate waterproof service risers to prevent consequential damage to the construction and damage to electrical building services as Principle F;

Principle N.9

Service risers and smoke shafts constructed with a waterproof upstand

Service risers and smoke ventilation shafts as separate compartments are constructed with a waterproof upstand to prevent anticipated runoff of water from activated sprinklers and agreed firefighting operations;

Principle N.10

Lift shafts and protected stairs are all provided with a drainage system

Firefighting and evacuation lift shafts and protected stairs are all provided with a drainage system at each protected lobby, instead of any ramps, while the decision to allow fire hose water to fall through the passenger lift shafts drained at their base is discussed with insurers;

Principle N.11

Compartment wall and floor construction restricts wider damage

So far as reasonably practicable, compartment wall and floor construction restricts flame, heat, smoke, and water damage beyond the compartment as Principle I, including through cavities within compartmentation as Principle J;

Principle N.12

Consider pollutants in runoff from suppression systems and firefighting

Advice has been obtained from the Fire and Rescue Service on pollutants to be anticipated in runoff of water from activated sprinklers or other suppression systems and agreed firefighting operations, which may include foam chemicals;

Principle N.13

Agree runoff protection measures with the Environment Agency

Measures for preventing the anticipated runoff of polluted suppression system and firefighting water from entering groundwater are agreed with the Environment Agency and included in the Resilience Strategy; and

Principle N.14

Implement agreed runoff protection measures, and maintain as Principle Y

Agreements with the Fire and Rescue Service and the Environment Agency have been implemented to capture polluted suppression system and firefighting water runoff for safe disposal, and maintained as Principle Y.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle N are provided as BDM01-10.14.

9.15 Principle O – Facilitate Simple Repair

Principle O – Facilitate Simple Repair

Develop the design to technically resolve how a partially damaged building can be cost effectively repaired and be vigilant against proposed changes in construction Work Stages that diminish repairability, which should be declined under contract.

Essential Principle O will be satisfied by combination of the following actions:

Principle O.1

Construction selected to be cost effectively repaired should it be damaged

Construction materials, products, and systems are selected to be cost effectively repaired should they be damaged, either before handover at Work Stage 6 or during the use of the building at Work Stage 7;

Principle O.2

Resilience Strategy to the BS ISO 15686 series for Service Life Planning

The Resilience Strategy, as part of the contract documents, has required all materials, products, and systems that constitute the components that comprise the building to be designed, built, and maintained to criteria within the BS ISO 15686 series for Service Life Planning, to instruct the building owner or operator after handover on how they are to keep maintenance commitments as Principle Y;

Principle O.3

Technical hierarchy of primary, secondary, and tertiary components

By Work Stage 4, the client, through their consultants and any contractors, has developed the technical design to criteria within the BS ISO 15686 series for Service Life Planning to establish a hierarchy of primary, secondary, and tertiary components, selected with an understanding of their repairability;

Principle O.4

Primary components are demonstrably cost effective to repair

Primary components, such as the primary structure and the main elements of compartmentation, are demonstrably cost effective to repair;

Principle O.5

Demonstrate how secondary and tertiary components are to be replaced

Instead of repairability, the ease of replaceability of secondary and tertiary components is demonstrated;

Principle 0.6

Practical experiments to cost effectively repair construction prototypes

Where existing demonstrations are not readily available, practical experiments are undertaken before contracts are entered into, to repair construction prototypes inflicted with a considered range of likely damage, to establish that the component selections of materials, products, and systems will be cost effectively repairable;

Principle 0.7

Agree aesthetic qualities of repairs when damage remains visible after repair

Agreement is reached prior to contract on the aesthetic qualities of repairs, when it may be possible to see that damage has been repaired;

Principle 0.8

Methods of repair recorded and samples of repairs kept at contract tender

Methods of repair are recorded and samples of repairs kept by the client and their consultants to advise the contractors as the project is tendered for contract; and

Principle 0.9

Attempts at "Value Engineering" declined where repairability is diminished

Attempts at "Value Engineering" are declined under contract where repairability of proposed substitutes for specified and carefully selected materials, products, and systems may be diminished.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle 0 are provided as BDM01-10.15.

9.16 Principle P – Plan Salvage Operations

Principle P – Plan Salvage Operations

Plan enhanced protection and subsequent salvage of valuable building contents, so far as reasonably practicable, including any important or irreplaceable furniture, fixtures, and equipment, in ways compatible with firefighting operations.

Essential Principle P will be satisfied by combination of the following actions:

Principle P.1

Fire and Rescue Service consulted on the Emergency Response Plan

The Fire and Rescue Service has been consulted as Principle C.1 on practical ways to salvage valuable building contents, bringing in salvage specialists as consultants to develop the dialogue, which is to be developed as an Emergency Response Plan (ERP), without a risk to health and life safety or obstruction to the Fire and Rescue Service in operational duties, and incorporated into the Resilience Strategy as Principle A;

Principle P.2

Irreplaceable contents are securely kept in non-combustible buildings

Contents which are irreplaceable are securely kept in non-combustible parts of buildings as Principle D.1, without combustible materials as Principle D.2, with extended structural stability as Principle H and enhanced compartmentation as Principle I.1, without sprinklers or other suppression systems where the contents will be damaged, and with detection and alarm systems of the highest quality as Principle R, to provide more time for planned salvage operations; and

Principle P.3

Buildings or large immovable objects have temporary property protection

Buildings or large immovable objects of historic interest have temporary property protection measures that can be brought to them, that increase the expectation of saving their fabric, in addition to satisfying health and life safety.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle P are provided as BDM01-10.16.

9.17 Principle Q – Follow Identified Standards

Principle Q – Follow Identified Standards

Identify and closely follow standards for life safety and asset protection, avoiding selective "cherry picking" between standards, fully disclosing test reports and fire engineering assessments signed and dated by competent Fire Engineers.

Essential Principle Q will be satisfied by combination of the following actions:

Principle Q.1

Design development identifies primary, secondary, and tertiary components

Design development has identified primary, secondary, and tertiary components as Principle O, and technical design development is required throughout Work Stage 4 to produce the project Specification as a contract document, which shall be informed by the Evacuation, Fire, and Resilience Strategy documents;

Principle Q.2

Classification structure of the project specification facilitates comprehension

The classification structure of the project specification facilitates comprehension of, and easy access to, the substantial technical content generated through iterative design development, in reference to current product and test standards;

Principle Q.3

Specifications are written either prescriptively or descriptively

Specifications are either written prescriptively, for actual materials, products, and systems on the market, or descriptively, defining characteristics and performances that several marketed materials, products, and systems can provide;

Principle Q.4

Standards specified or referred to shall be purchased, read, and understood

Standards specified or referred to shall be purchased, read, and understood by consultants and contractors, who will follow them without selective "cherry picking" between standards to gain advantage;

Principle Q.5

Obtain confirmation from the building control inspector for new versions

Where standards or guidance documents are referred to in statutory guidance to the Building Regulations, but the issuing body has revised or updated the listed version of the standard or guidance document, the new version shall be referred to after obtaining confirmation from the building control inspector that the new version addresses the legal requirements of the Building Regulations; and

Principle Q.6

Manage the need for project specific performance testing as Principle S

Selections for materials, products, and systems favours reputable manufacturers who are willing to fully disclose valid third party certified performance tests, signed and dated no more than five years before the procurement date, that can help manage the need for project specific performance testing as Principle S.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle Q are provided as BDM01-10.17.

9.18 Principle R – Provide Reliable Detection

Principle R – Provide Reliable Detection

Install a comprehensive automatic fire alarm system based on high-integrity detectors to prevent false alarms, so far as reasonably practicable, installed and commissioned by specialist operatives who should also provide user training.

Essential Principle R will be satisfied by combination of the following actions:

Principle R.1

Category P1 system including manual call points throughout the building

As an enhancement on a Category L system for life safety, a detection and alarm system is installed to BS 5839 *Fire detection and fire alarm systems for buildings* for non-domestic premises in Part 1, to Category P1, to additionally include manual call points throughout the building, making provisions for inner rooms, and an Emergency Voice Communication (EVC) system at protected "refuges" in the absence of a universal Evacuation Strategy;

Principle R.2

Integration of other systems to activate the detection and alarm system

Requirements of BS 7273 *Code of Practice for the operation of fire protection measures* in six Parts have been complied with as Principle F, where other systems, such as sprinklers to the LPC Sprinkler Rules as Principle I.2, are interfaced to activate the detection and alarm system;

Principle R.3

BS EN 54 series compliance and the Alarm Receiving Centre

The detection and alarm system is to BS EN 54-1:2011 *Fire detection and fire alarm systems Part 1: Introduction*, comprising components manufactured in the series of Parts of BS EN 54, and linked to an Alarm Receiving Centre (ARC);

Principle R.4

Communication of real fire signatures from high-integrity hardware

Communication of real fire signatures to the ARC is by a method that identifies it as originating from high-integrity hardware in the system;

Principle R.5

Smoke tight construction as Principle F.2 separating detection and alarm

Smoke tight construction is achieved as Principle F.2 to separate the detection and alarm systems from smoke leakage between compartments, following consultation with the Fire and Rescue Service as Principle C.17, with toxic smoke exposure additionally considered as Principle C.18 as a further question of design.

Principle R.6

Single system by third party certified specialists using quality components

One system for the whole building is installed and commissioned by specialist operatives fully trained and supervised under third party certified schemes using quality components as Principle T and to a standard of work as Principle U;

Principle R.7

User training in system operation provided to the facilities manager

User training in the operation of the system is provided to the facilities manager appointed by the building owner or operator to achieve Principle W;

Principle R.8

Maintenance contracts with the original installer for a better service

Maintenance contracts as Principle Y are placed where commercially viable with the original installers to encourage commitment to a better service; and

Principle R.9

Statutory duty holder remains continually satisfied throughout building use

Fire Safety Information at Work Stage 6, required by Regulation 38 in the Building Regulations 2010, satisfied the "Responsible Person" as Principle V, and the statutory duty holder remains continually satisfied through Work Stage 7. With recognition of changed patterns of building use, particularly for inner rooms and when storeys are divided without compartmentation as Principle I.1 into areas of occupancy, whether or not under separate owners or operators, critically reviewed as Principle Z against the Resilience Strategy assumptions as Principle A.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle R are provided as BDM01-10.18.

9.19 Principle S – Complete Performance Tests

Principle S – Complete Performance Tests

Programme and decisively complete specified and contracted performance testing, inspection, and certification to show compliance, and achieve client acceptance of results in a timely manner, to prevent performance deficiencies under contract.

Essential Principle S will be satisfied by combination of the following actions:

Principle S.1

Specify project performance tests that shall be completed to a programme

The project Specification as a contract document, informed by the Evacuation, Fire, and Resilience Strategy documents, defines a number of project performance tests that shall be completed to a programme structured to address the discipline of Strategy, Testing, Inspection, Certification, and Compliance (STICC);

Principle S.2

Schedule submittals identified in the project Specification, including tests

Submittals identified by the consultants in the project Specification are scheduled to distinguish between materials, products and systems to be procured as Principle T, which either already have valid third party certified performance tests, obtained as Principle Q, or which require performance testing for the project;

Principle S.3

Contractors issued with project Specification Submittal List at tender stage

Contractors are issued with the project Specification Submittal List breakdown at tender stage for a realistic tender process before contract, and demonstrate comprehension of the programme and cost implications of the project specific performance testing;

Principle S.4

United Kingdom Accreditation Service (UKAS) accredited test authorities

Only United Kingdom Accreditation Service (UKAS) accredited test authorities shall be recognised, either for existing test reports and assessments, or for project specific performance tests that may require further assessment;

Principle S.5

Programme for the eventuality testing may fail and retesting is necessary

Time is allowed in the contractor's programme for the eventuality that project specific performance testing may fail, when redesign and retesting is necessary;

Principle S.6

Programme acceleration and cost savings are no reason for test cancellation

Programme acceleration and cost savings are not a reason to cancel project specific performance tests;

Principle S.7

Smoke Leakage (S) rate for smoke ventilation shaft and compartmentation

Smoke ventilation shafts as Principle F.2 and other compartmentation as Principle I.17 are designed and built from construction third party certified to achieve a Smoke Leakage (S) rate expressed in Minutes as Principle I.1, tested from both sides at ambient temperature and the expected fire temperature;

Principle S.8

Tested construction smoke toxicity when considering combustible materials

Testing of construction materials for smoke toxicity in their acute and chronic effects on health and life safety is referred to when decisions to use combustible materials are made as Principle D.2, in support of the consultation with the Fire and Rescue Service as Principle C.18;

Principle S.9

Welcome witnesses of critical project specific performance tests

Requests by insurers and the Fire and Rescue Service to witness critical project specific performance tests are welcomed by contractors and, whether attending or not, they receive full disclosure of third party certified test reports and assessments in good time to be able to provide advice to the client; and

Principle S.10

Full disclosure of third party certified test reports and assessments

The natural person representing the client as Principle A.5, and if appointed the "Responsible Person", are invited by contractors to witness performance testing and, whether attending or not, receive full disclosure of third party certified test reports and assessments in good time to be able to provide advice to the client.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle S are provided as BDM01-10.19.

9.20 Principle T – Procure Quality Materials

Principle T – Procure Quality Materials

Insist upon the procurement of materials, products, and systems with third party certification schemes accredited by the United Kingdom Accreditation Service, with proof of service life in application and full disclosure of fire safety information.

Essential Principle T will be satisfied by combination of the following actions:

Principle T.1

Satisfy Regulation 7(1)(a) of the Building Regulations 2010

All materials in products and systems used to construct the building satisfy Regulation 7(1)(a) of the Building Regulations 2010, as amended 2018 and 2022, as BDM01-12, including the substrates with any formed openings and cavities into which third party certified materials, products, and systems are installed;

Principle T.2

Terminology for Principle O explained to and understood by contractors

Terminology developed in design to facilitate simple repair as Principle O was explained to and understood by contractors when procuring quality materials, and consolidated into the verified recorded information as Principle V;

Principle T.3

Check certification of manufacturers by Conformity Assessment Body (CAB)

The client through their consultants and contractors collaborate to check the scope of certification of material, product, and system manufacturers by third party Conformity Assessment Bodies (CABs), and they are accredited by the United Kingdom Accreditation Service (UKAS);

Principle T.4

Direct Field of Application (DIAP) and Extended Field of Application (EXAP)

Use of materials, products, and systems is third party certified either on the basis of Direct Field of Application (DIAP) testing by a UKAS accredited test authority, or otherwise fire engineering assessed for an Extended Field of Application (EXAP);

Principle T.5

Full disclosure of as-tested specimens or prototypes in DIAP test reports

All DIAP test reports provide third party certifiers with full disclosure of as-tested specimens or prototypes, which shall correspond to the samples, mock-ups, and benchmarks the consultants specified and accepted, and the testing process;

Principle T.6

Complexity of EXAP assessment and competence of the assessor

All EXAP assessments are undertaken with regard to the complexity of assessment and the competence of the assessor in their training and experience;

Principle T.7

Concealed fire protection is designed for practical verification as Principle V

Concealed fire protection materials, products, and systems such as cavity barriers and fire stopping are designed for practical verification as Principle V;

Principle T.8

Suitability of as-built fire protection after change of use or construction

When any change of building use or construction occurred, the suitability of the existing fire protection was re-assessed by a competent and experienced fire engineer with sufficient knowledge of the complexity of the building, the changes, and the materials, products and systems in question, as an aspect of Principle W;

Principle T.9

Refurbishment is undertaken and completed while unoccupied between uses

Refurbishment is undertaken and completed in a period of transition between uses, not while the building is occupied, where change of use requires modification and upgrade of fire protection products and systems;

Principle T.10

Comprehensive automatic fire detection and alarm system as Principle R

A comprehensive automatic fire alarm system based on high-integrity detectors to prevent false alarms is provided as Principle R, installed and commissioned as Principle U, to operate in accordance with the Evacuation Strategy agreed in consultation with the Fire and Rescue Service as Principle C; and

Principle T.11

Fire Safety Information for Regulation 38 in the Building Regulations 2010

Fire Safety Information at Work Stage 6, required by Regulation 38 in the Building Regulations 2010, satisfied the "Responsible Person" as Principle V, and the statutory duty holder remains satisfied through Work Stage 7.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle T are provided as BDM01-10.20.

9.21 Principle U – Require Competent Work

Principle U – Require Competent Work

Confirm protection measures are installed by identified specialists, trained and supervised under third party quality of work schemes accredited by the United Kingdom Accreditation Service, with full disclosure of fire safety information.

Essential Principle U will be satisfied by combination of the following actions:

Principle U.1

Satisfy Regulation 7(1)(b) of the Building Regulations 2010

Quality of work to construct the building satisfies Regulation 7(1)(b) of the Building Regulations 2010, as amended 2018 and 2022, as BDM01-12;

Principle U.2

Identified operatives are third party certified under a quality of work scheme

Identified operatives working for all specialist contractors, including fire protection installers, are third party certified under a quality of work and management scheme to install specific products and systems as Principle T;

Principle U.3

Schemes are accredited by the United Kingdom Accreditation Service (UKAS)

Quality of work and management third party certification schemes are accredited by the United Kingdom Accreditation Service (UKAS) to satisfy Regulation 7(1)(b) as Principle U.1;

Principle U.4

Understand the technical meaning of all test reports and assessments

Third party certified contractors and their sub-contracted installers shall be issued with and confirm understanding of the technical meaning of all test reports and assessments that have either been undertaken as Principle S or supplied in procurement as Principle T, in a process of full disclosure, under their third party certification;

Principle U.5

Check the suitability of substrates with any formed openings and cavities

Preparatory checking of the suitability of substrates with any formed openings and cavities into which fire protection materials, products, and systems are installed is also part of the third party certification of specialist fire protection installers;

Principle U.6

Maintenance contracts with original installers to encourage better service

Maintenance contracts as Principle Y are placed where commercially viable with the original installers to encourage commitment to a better service;

Principle U.7

Comprehensive automatic fire alarm system with high-integrity detectors

A comprehensive automatic fire alarm system based on high-integrity detectors to prevent false alarms is provided as Principle R, to the quality expected in Principle T, installed and commissioned to operate in accordance with the Evacuation Strategy agreed in consultation with the Fire and Rescue Service as Principle C to the satisfaction of the "Responsible Person" as Principle V; and

Principle U.8

Fire Safety Information for Regulation 38 in the Building Regulations 2010

Fire Safety Information at Work Stage 6, required by Regulation 38 in the Building Regulations 2010, satisfied the "Responsible Person" as Principle V, and the statutory duty holder remains satisfied through Work Stage 7.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle U are provided as BDM01-10.21.

9.22 Principle V – Verify Recorded Information

Principle V – Verify Recorded Information

Accept only pertinent and accurate information at handover, insisting contractors satisfy statutory and contractual duties, checking record information provides full disclosure of the premises as built and commissioned for facilities management.

Essential Principle V will be satisfied by combination of the following actions:

Principle V.1

Design and construction is reviewed against the Resilience Strategy

The design and construction is reviewed by the client appointed natural persons for consistency with the Evacuation and Fire Strategies, and further with the Resilience Strategy as BDM01-4, who shall check the discipline of Strategy, Testing, Inspection, Certification, and Compliance (STICC) as Principle S;

Principle V.2

Demonstrate the smoke control system to the Fire and Rescue Service

The completed smoke control systems, including any smoke ventilation shafts, are demonstrated in operation to the Fire and Rescue Service based on consultation as Principles C.15, C.16 and C.17, constructed as Principle D.12 using construction tested for viability as Principle S.7, tested complete as Principle F.2, integrated with the detection and alarm system as Principle R.2, commissioned to a Soft Landing as Principle F, with the maintenance commitment as Principle Y explained by the "Principal Contractor" to the natural person appointed by the client as Principle A, or to the "Responsible Person" if available as the legal duty holder;

Principle V.3

Schedule of primary, secondary, and tertiary components for maintenance

The consultants and contractors have collaborated to provide the client with a schedule of primary, secondary, and tertiary components comprising the building that has been developed in design for repairability as Principle O and procured as Principle T, to be used to keep maintenance commitments as Principle Y. This schedule is supported with drawings and sufficiently technical explanations of operational and maintenance requirements, submitted in edited form in support of the Regulation 38 Fire Safety Information, and verified as the Building Manual;

Principle V.4

Concealed secondary or tertiary components accessible for maintenance

Concealed secondary or tertiary components identified as Principle O, such as some fire stopping and cavity barriers, are designed and constructed to be safely accessed for practical verification of continuing service life over the design life of the building, ensuring fire safety management can be undertaken as Principle W, statutory assessments completed and actioned as Principle X, and maintenance commitments kept as Principle Y;

Principle V.5

Photographic record of installation of inaccessible but critical components

Inaccessible but critical components that cannot be inspected, repaired, maintained or replaced, such as primary structure or compartmentation that depends upon fire stopping as Principle J.8, which are third party certified as Principles T and U, are to be photographically recorded in every location as they are installed. The opportunity for photography shall not be missed, and planned into the construction methodology. The photographic record shall be collated, and submitted as evidence in support of the Regulation 38 Fire Safety Information;

Principle V.6

Final Movements and Tolerances Report verified in a single collated survey

The final Movements and Tolerances Report is verified in a collated survey undertaken by the "Principal Contractor", not by disparate surveys delegated to several sub-contractors, for all critical joints and interfaces agreed with the client's consultants in the contract, to show that the structure and supported construction accommodate movements and tolerances in both non-fire and fire situations;

Principle V.7

Residual CDM 2015 Health and Safety file from the "Principal Contractor"

The Health and Safety file required by the Construction (Design and Management) Regulations 2015 is resolved by the "Principal Contractor" to a residual list;

Principle V.8

Full disclosure of failure to satisfy Evacuation, Fire, and Resilience Strategies

Investors acting either as or through the client obtain full disclosure of aspects of the building design and construction that fail to satisfy the contracted Evacuation, Fire, and Resilience Strategies, referencing BDM01 Principles D to Y, with proposals for how the works can be remediated under contract, prior to handover;

Principle V.9

Realisation of Evacuation, Fire, and Resilience Strategies in Work Stage 5

Realisation of the Evacuation, Fire, and Resilience Strategies is verified through the draft Regulation 38 Fire Safety Information exchange and confirmed by the natural person appointed by the client as Principle A, or by the "Responsible Person" if available as the legal duty holder, before the end of Work Stage 5;

Principle V.10

"Responsible Person" informed of unresolved discussions and agreements

When appointed by the building owner or operator under the Regulatory Reform (Fire Safety) Order 2005, the "Responsible Person" is informed of all discussions with insurers as Principle B and with the Fire and Rescue Service as Principle C, and about unresolved non-compliances with the contracted Resilience Strategy prior to handover and building occupation, encouraging their early appointment;

Principle V.11

Fire Safety Information is focused and distinct from the Building Manual

Fire Safety Information required by Regulation 38 of the Building Regulations 2010 is focused, and distinct as a separate set of documents from the verified Building Manual, though the content in the former for the "Responsible Person" may be duplicated or reformatted in the latter for the facilities manager;

Principle V.12

Regulation 38 Fire Safety Information is signed and dated for handover

Regulation 38 Fire Safety Information is signed and dated to the satisfaction of the "Responsible Person" appointed by the building owner or operator under the Regulatory Reform (Fire Safety) Order 2005, as sufficient for them to begin to undertake their statutory duty when the building is offered for handover;

Principle V.13

Fire Safety Information and Building Manual available to insurers on request

Copies of Fire Safety Information signed and dated by the "Responsible Person" and the verified Building Manual shall be made available to insurers on request who shall be consulted as Principle B;

Principle V.14

Verify compliance with the Employer's Requirements and Resilience Strategy

Compliance of the building works with the Employer's Requirements or contract documents, including but not limited to the Resilience Strategy, is verified by the investors acting either as or through the client and their consultants before handover at Work Stage 6, with expectations as agreed in the contract; and

Principle V.15

Handover is prepared for by the "Principal Contractor" under contract

Handover is not a matter of waiting for Work Stage 6, and is prepared for by the "Principal Contractor" under contract from commencement of the construction phase as Work Stage 5. The client shall make preparation for handover a task to be recognised and agreed at tender stage, as a criterion for the contract.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle V are provided as BDM01-10.22.

9.23 Principle W – Manage Fire Safety

Principle W – Manage Fire Safety

Provide fire safety management services to the satisfaction of the statutory duty holders appointed by the building owner and, if different, the building operator, including induction and training in fire safety for building users on the premises.

Essential Principle W will be satisfied by combination of the following actions:

Principle W.1

Training in duties imposed by Regulatory Reform (Fire Safety) Order 2005

Formal training in the duties imposed by the Regulatory Reform (Fire Safety) Order 2005 has been completed as early as possible by the building owner and, if different, the building operator to enable them to appoint their "Responsible Person" to relieve the client's natural person, as Principle V;

Principle W.2

Residual matters in the CDM 2015 Health and Safety File resolved

All residual matters in the CDM 2015 Health and Safety File have been resolved by the "Principal Contractor" before the expiry of the Defects Liability Period after Work Stage 6 handover;

Principle W.3

Copy of the Building Manual for operational and maintenance information

A copy of the Building Manual providing operational and maintenance information is made available in an accessible and printable format on the premises, and kept current by a dedicated individual information controller who will provide information on request;

Principle W.4

Components replaced where degraded more rapidly than expected

Consequential damage limitation measures as Principle N are maintained and components are replaced where they have degraded more rapidly through building use or abuse than is expected by their declared service life;

Principle W.5

Waterproofing and drainage reinstated when modifications are undertaken

Waterproofing and drainage to satisfy Principle N are maintained and if necessary reinstated when modifications to internal fit out are undertaken, particularly in kitchens and sanitary accommodation, or when balconies and roofs are repaired or replaced over the life of the building, including works on green roofs and walls;

Principle W.6

Green roofs and walls maintained under professional contract as Principle Y

Intensively or extensively planted green roofs and walls are maintained as Principle Y under a professional contract in prompt response to weather conditions over the seasons as Principle M.9, to prevent the plants and their growing media drying out or a volume of organic material accumulating as a potential fire load;

Principle W.7

Conditions on building contents related to use are imposed and enforced

Conditions on building contents related to use are imposed in accordance with the insurance, both internally within accommodation, and externally around the building on balconies and roofs;

Principle W.8

Moveable heating and ventilation appliances controlled in their use

Integrated building services are monitored as Principle F, but moveable heating and ventilation appliances where not designed out are strictly controlled by facilities managers, who shall address their use in assessments as Principle X.4;

Principle W.9

Personal Emergency Evacuation Plans (PEEPs) are established and practised

A Personal Emergency Evacuation Plan (PEEP) is established for any user, as a "Relevant Person", who cannot escape from a building unaided. All PEEPs are practised at the same time as all occupants exercising self-evacuation practise escape to a place of safe assembly, with the "Responsible Person" as a witness to fire safety management. Any PEEP discovered to be inadequate shall be revised and practised again, until the user and the "Responsible Person" are satisfied;

Principle W.10

Building owner or operator meets new building users and provides training

The building owner and, if different, the building operator have established arrangements to meet all new building users and to keep them informed over time with practical training in aspects of fire safety while on the premises;

Principle W.11

Practise "fire drills" and improve the Evacuation Strategy following the alarm

Reliable fire detection and alarm systems installed and commissioned as Principle R, with user training provided, are regularly inspected, tested and promptly maintained as Principle Y, with "fire drills" to practise and improve the Evacuation Strategy, in consultation with the Fire and Rescue Service as Principle C;

Principle W.12

Construction re-assessed as Principle X and maintained as Principle Y

Fire protection materials, products, and systems as Principle T installed as Principle U, with user training provided, are verified as Principle V, re-assessed over their service life by a competent and experienced fire engineer as Principle X, and regularly inspected, tested, and promptly maintained as Principle Y;

Principle W.13

Accessibility unaffected by Furniture, Fixtures and Equipment (FF&E)

Accessibility of concealed cavity barriers and fire stopping is unaffected by changes to Furniture, Fixtures and Equipment (FF&E), to ensure access for verification as Principle V, assessment as Principle X, and maintenance as Principle Y;

Principle W.14

Combustible contents as an occupational fire load not exceeded by users

Combustible contents described and defined as an occupational fire load expected for the occupational use as Principle G.4, providing assumptions for sprinkler protection and compartment size as Principle I, are not exceeded by users;

Principle W.15

Review fire safety measures and procedures for insurance policies

Insurers are invited by the facilities manager, the "Responsible Person", and the building owner or operator to review fire safety measures and procedures at times that relate to inceptions of new and renewals of existing insurance policies; and

Principle W.16

Record of FRAs and FRAEWs made available to insurers on request

Printable copies of signed and dated statutory Fire Risk Assessments (FRAs) and Fire Risk Appraisals of External Walls (FRAEWs) are made available to insurers on request, with proposals for action as Principle X.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle W are provided as BDM01-10.23.

9.24 Principle X – Action Statutory Assessments

Principle X – Action Statutory Assessments

Instruct, review, and promptly act upon Fire Risk Assessments that consider the scale or complexity of the building and the activities undertaken by building users on the premises, keeping a written record of assessments and actions over time.

Essential Principle X will be satisfied by combination of the following actions:

Principle X.1

The "Responsible Person" has carried out and reviewed FRAs and FRAEWs

The "Responsible Person" has carried out and regularly reviewed Fire Risk Assessments (FRAs) and Fire Risk Appraisals of the External Wall (FRAEWs);

Principle X.2

Matters arising from the FRAs and FRAEWs are promptly actioned

Matters arising from the FRAs and FRAEWs are promptly actioned by facilities managers, who maintain a written record and advise the "Responsible Person" as required works are completed;

Principle X.3

All building services access panels with fire resistance are kept locked

All building services access panels with fire resistance as Principle I are kept locked when not in use and checked by the facilities manager as an aspect of fire safety management, with keys formally issued to and returned by fire risk assessors;

Principle X.4

Moveable heating and ventilation appliances addressed in the FRA period

Use of moveable heating and ventilation appliances is recorded and assessed as a wider problem of discomfort, with consequences for fire safety addressed in the FRA period when the appliances are identified; and

Principle X.5

Moveable equipment with lithium-ion batteries addressed in the FRA period

Moveable equipment with lithium-ion batteries that require storage and charging is recorded and assessed as a wider problem of security, with consequences for fire safety addressed in the FRA period when the equipment is identified.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle X are provided as BDM01-10.24.

9.25 Principle Y – Keep Maintenance Commitments

Principle Y – Keep Maintenance Commitments

Inspect regularly, test and, when required, promptly maintain or replace structure, construction or building services systems over the life of the building, employing specialist operatives trained and supervised under third party certified schemes.

Essential Principle Y will be satisfied by combination of the following actions:

Principle Y.1

Sprinklers serviced and maintained by BAFSA accredited contractors

Sprinklers installed to reduce the severity of fire as Principle I are serviced and maintained by specialist contractors in accordance with the RISCAuthority *Sprinkler System Service and Maintenance: Guidance, Records and Checklists* June 2021, accredited by the British Automatic Fire Sprinkler Association (BAFSA);

Principle Y.2

Service Life Planning resulting in a Maintenance Strategy and simple repair

All materials, products, and systems that constitute the components that comprise the building are designed, built, and maintained to criteria within the BS ISO 15686 series for Service Life Planning, resulting in a Maintenance Strategy, and design development at Work Stage 4 has facilitated simple repair as Principle O;

Principle Y.3

Schedule of primary, secondary, and tertiary components as Building Manual

The schedule of primary, secondary, and tertiary components comprising the building, supported with drawings and sufficiently technical explanations of operational and maintenance requirements, verified as the Building Manual by Work Stage 6 as Principle V, is referred to, acted upon, and kept current;

Principle Y.4

Identified operatives third party certified for construction as Principle T

Identified operatives working for specialist fire protection installers are third party certified under a scheme to install specific products and systems as Principle T;

Principle Y.5

Quality of work and management third party certification schemes

Quality of work and management third party certification schemes are accredited by the United Kingdom Accreditation Service (UKAS) as Principle U;

Principle Y.6

Compartmentation not impaired over time by degradations and breaches

Fire resisting and smoke tight compartment wall and floor construction with fire doors and fire stopped building services is inspected and maintained to ensure Principle I is not impaired over time by degradations to and breaches in the compartmentation, with repairs promptly carried out;

Principle Y.7

All building services access panels with fire resistance are kept locked

All building services access panels with fire resistance as Principle I are kept locked when not in use and checked by the facilities manager as an aspect of fire safety management, with keys formally issued to and returned by instructed operatives;

Principle Y.8

Drainage for rainwater from roofs accessed to monitor and maintain

Drainage for rainwater from roofs, including blue roofs, terraces, balconies, canopies, or water management details such as flashings in the external envelope, are easily and safely accessed to monitor for blockages and undertake maintenance;

Principle Y.9

Drainage for soil waste and grey water accessed to monitor and maintain

Drainage for soil waste and grey water from catering and sanitary facilities is easily and safely accessed to monitor for blockages and undertake maintenance;

Principle Y.10

Drainage to waterproofed areas accessed to monitor and maintain

Drainage to waterproofing to minimise consequential damage from activated sprinkler water or leaks from systems as Principle N is easily and safely accessed to monitor for blockages and undertake maintenance;

Principle Y.11

Solid waste refuse chutes and storage accessed to monitor and maintain

Solid waste refuse chutes and storage are safely accessed to clear blockages and undertake maintenance, and secured to anticipate arson attempts as Principle E;

Principle Y.12

Sprinkler system pressure is in accordance with the LPC Sprinkler Rules

Sprinkler system pressure is in accordance with the LPC Sprinkler Rules as Principle I.2, checked for leaks and maintained to prevent consequential damage as Principle N.6;

Principle Y.13

Pressure of all water systems other than sprinkler systems limited to 3.0 bar

Pressure of all water systems other than sprinkler systems as Principle N.6 is limited to 3.0 bar, checked for leaks and maintained as Principle N.7;

Principle Y.14

Water system outlet temperatures limited to a maximum 48°C

Water system outlet temperatures are limited to a maximum 48°C to prevent scalding in general use, unless hotter water is a specified feature of a maintained installation with use controlled by facilities management under the Health and Safety at Work etc. Act 1974;

Principle Y.15

SAEMA advice is followed, including a commitment to operative training

Guidance from the Specialist Access Engineering and Maintenance Association (SAEMA) is followed, including a commitment to training;

Principle Y.16

Maintenance works are undertaken in compliance with LOLER and PUWER

Maintenance works are undertaken in compliance with the Lifting Operations and Lifting Equipment Regulations (LOLER) and the Provision and Use of Work Equipment Regulations (PUWER), as amended since 1998; and

Principle Y.17

Scrupulous records of inspection and maintenance are kept for insurers

Scrupulous records of inspections and maintenance carried out are kept and made available to insurers on request, including photographic records, with updates to the Building Manual as a comprehensive and dynamic record of risk management.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle Y are provided as BDM01-10.25.

9.26 Principle Z – Critically Review Experience

Principle Z – Critically Review Experience

Review whether the aspects of resilience originally required of the asset were realised practically over time, and share lessons learned to strengthen a culture of disclosure which can inform insurable strategies for future development projects.

Essential Principle Z will be satisfied by combination of the following actions:

Principle Z.1

Long term relationship to undertake a Post-Occupancy Evaluation (POE)

A long term relationship is built up between the building owner or operator and the insurer to be able to undertake a Post-Occupancy Evaluation (POE), allowing better appreciation of the changing occupancy of the building, the variability of contents, particularly in stocks or storage representing the fuel load, or the dynamic processes that are undertaken within it;

Principle Z.2

Culture of full disclosure for lessons learned in public, not only on project

Conscious effort is made to encourage a culture of full disclosure, so that lessons can be shared and learned in public, and not only within limits to confidentiality of the project;

Principle Z.3

Success from one Resilience Strategy is repeated by strategists that follow

Success from one Resilience Strategy is repeated by strategists that follow, which means sharing experience, knowledge, and insight between projects; and

Principle Z.4

Adopt Strategy, Testing, Inspection, Certification, and Compliance (STICC)

BDM01 *A to Z of Essential Principles* is improved by contributors over time, with a focus on Strategy, Testing, Inspection, Certification, and Compliance (STICC), discussed as Principle S in BDM01-10.19.

Supporting notes for understanding and interpretation in pursuit of satisfying the checklist of actions for Essential Principle Z are provided as BDM01-10.26.

10 A to Z Essential Principles supporting notes

10.1 Principle A – Strategically Assess Resilience

Principle A – Strategically Assess Resilience

Assess susceptibility, vulnerability, and recoverability in the structure, construction, and services systems against risks in fire, escape of water, and flooding, to define a strategy for the development project, to be critically reviewed over time.

A.1 Investors acting as or through the client decide to invest in a resilient asset

A.2 Client consults early with insurers and the Fire and Rescue Service

A.3 Assessments of resilience to fire and water damage inform a Project Brief

A.4 Briefing documents are developed through design into a Resilience Strategy

A.5 Client appoints a natural person as their proxy for the statutory duty holder

A.6 Resilience Strategy develops through design into Employer's Requirements

A.7 Monitoring by the client's natural person through the construction phase

A.8 Insurers are informed of non-compliances as Principle B.12

A.9 Fire and Rescue Service is informed of non-compliances as Principle C.22

A.10 When appointed, the statutory duty holder is informed of non-compliances

A.11 Investors acting as or through the client obtain full disclosure of progress

A.12 Confirmation from the statutory duty holder on health and life safety

Damaging events

Damage from fire and water events can displace people from their homes, cause loss of irreplaceable personal possessions, incur great disruption and financial cost and, in some instances, lead to businesses failing. Poorly designed buildings can also lead to serious personal injury and death among both occupants and the Fire and Rescue Service, who may be unable to extinguish a fire. For investors in buildings there are legal, financial and reputational risks in fire and water events.

Prospect of losses

Whether investing as or through the client, investors may find to their cost that they are legally free to ignore property or asset protection, or resilience more widely. Their investment may be lost in the event of a fire, or seriously affected by water related incidents, which may be a consequence of firefighting.

Any ambition of the investor to achieve resilience in addition to health and life safety shall be communicated to the consultants and contractors through the Resilience Strategy.

Protect investment

The law expects investors in buildings to look after their own investments. Which includes insuring them against loss to fire or water related events.

Risk investment

If the decision is to disregard the resilience of the building and accept disruption to the activities of the occupants, then following BDM01-16 (E-AD-B) as statutory guidance to the Building Regulations 2010 in England may appear to be sufficient for health and life safety, subject to the project being a "common building situation". However, some caution is required.

Two complications

There is no guarantee statutory guidance may be relied upon, for two reasons.

Flawed guidance

Firstly, the statutory guidance may be flawed. Fatalities that occurred as a result of the Grenfell Tower fire on 14 June 2017, and at the Lakanal House fire on 3 July 2009, were a high price to pay to discover Class 0 in BDM01-16 (E-AD-Bv2)(2006 as amended 2010 and 2013) as an egregious example of statutory guidance being insufficient for health and life safety through the Building Regulations 2010.

Discoveries of the Grenfell Tower Inquiry in 2022 show that Class 0 should have been withdrawn after 2000. The case of Class 0 is further considered in relation to Principles D and K later in this document.

Class 0 was not a weakness in statutory guidance that either the government or specialist fire engineers in industry had publicly identified to the wider construction industry prior to Grenfell Tower fire. It is worth remembering that oversight when advocating fire safety engineering in pursuit of building resilience in addition to health and life safety, as this document does. Nevertheless, the discipline of thinking strategically about resilience is to be encouraged, as the best available approach to expose the insufficiency of compliance with statutory guidance.

Unsuitable guidance

Secondly, the statutory guidance may be unsuitable. The statutory guidance published in updated and extending Parts, and combined periodically as a single document, carry a caveat that changes in wording over time:

"Although approved documents cover common building situations, compliance with the guidance set out in the approved documents does not provide a guarantee of compliance with the requirements of the regulations because the approved documents cannot cater for all circumstances, variations and innovations. Those with responsibility for meeting the requirements of the regulations will need to consider for themselves whether following the guidance in the approved documents is likely to meet those requirements in the particular circumstances of their case."

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1010058/Single_stitched_together_pdf_of_all_ADs__Jul21_.pdf

Unfortunately neither Volume 1 Dwellings nor Volume 2 Buildings other than dwellings of BDM01-16 (E-AD-B) defines what is meant by a "common building situation". The client can design down to the "life safety before collapse" objective on the assumption that the project is a "common building situation", using "common" construction techniques.

BDM01 Keynote

RISCAuthority BDM01 *A to Z of Essential Principles* for the protection of buildings is an orderly recommendation to investors, on behalf of insurers, not to design and build solely down to the "life safety before collapse" objective on the assumption that the project is a "common building situation". Instead, to define and insist upon the resilience their investment requires, beyond statutory guidance or Building Regulations. It calls for resilient construction innovation to improve health and life safety with measures anticipating likely events involving fire and water.

MMC innovation

Where construction methods are novel, for which the elastic policy jargon of Modern Methods of Construction (MMC) is often used, they may not be considered a "common building situation". This requires discretion about innovation in the construction industry. Not all change is an advance, even if the changes gain a wide application in the market.

Market forces allow costs and disbenefits to be offset to others. Which may be commercially motivated when the client has no vested interest in becoming the building owner or operator after handover. The disjunction in property ownership over the life of a building can lead to hidden costs and false economies unless consciously confronted. This is a qualitative problem, and particularly so when the promoted innovation is adopted widely and rapidly to become a quantitative problem, or "common".

MMC market

There is considerable but often inconclusive academic study, and a proliferation of competing trade associations promoting their sector as leaders in MMC, even while caution is being raised among agencies with regulatory overview.

NFCC on MMC

The National Fire Chiefs Council (NFCC) published a *Modern Methods of Construction Policy Position Statement* on 6 December 2022, dated November 2022. This recommends government "... should provide clarity on the applicability or otherwise of Approved Document B to MMC considering factors such as construction type, use, height, size, and complexity of the building." There is a profound lack of clarity about the applicability of statutory guidance.

https://www.nationalfirechiefs.org.uk/news/nfcc-publishes-modern-methods-of-construction-position-statement/278529

https://www.nationalfirechiefs.org.uk/write/MediaUploads/Position%20statements/Protection/NFCC_MMC_Policy_Position_Statement__Final.pdf

Modernise or die

The NFCC position statement on MMC also made recommendations to government about the proposed MMC Taskforce, that follows the work of the MMC Cross Industry Working Group, established in 2017 and chaired by Mark Farmer of Cast Consultancy. This initiative had followed government publication of his *Modernise or die: The Farmer Review of the UK construction labour model*, in October 2016, endorsed by the asked the Construction Leadership Council (CLC), arguing it was "... time to decide the industry's future."

https://www.gov.uk/government/publications/construction-labour-market-in-the-uk-farmer-review

The Cast Consultancy publication of *Modernise or die* is here:

https://www.cast-consultancy.com/knowledge-hub/the-farmer-review-of-the-uk-construction-labour-model/

The government response to *Modernise or die* is here:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/630457/farmer-review-construction-labour-model-government-response.pdf

MMC Framework

The *Modern Methods of Construction (MMC) definition framework* published in March 2019 was developed by a specialist sub-group of the MMC Cross Industry Working Group. Nowhere in this government published framework for MMC is there a measure of what is "common" or "uncommon". It is not considered in this framework whether statutory guidance to the Building Regulations for health and life safety address MMC categories.

https://www.gov.uk/government/publications/modern-methods-of-construction-working-group-developing-a-definition-framework

Promoters of MMC may want to consider construction products and systems as common enough to not require a fire safety engineering approach, to encourage market reliance on the statutory guidance alone. After all, MMC committed manufacturers want market share. They want to become common in a way that the Ministry authors of statutory guidance decline to explicitly endorse. The policy push of MMC is disconnected from the legislated health and life safety concerns, which makes comprehension of the framework Categories difficult to comprehend.

Categories of MMC

- Category 1
  Pre-Manufacturing - 3D primary structural systems

- **Category 2**
  Pre-Manufacturing - 2D primary structural systems
- **Category 3**
  Pre-Manufacturing - Non-systemised structural components
- **Category 4**
  Pre-Manufacturing - Additive Manufacturing
- **Category 5**
  Pre-Manufacturing - Non-structural assemblies and sub-assemblies
- **Category 6**
  Traditional building product led site labour reduction / productivity improvements
- **Category 7**
  Site process led site labour reduction / productivity / improvements

www.cast-consultancy.com/wp-content/uploads/2019/03/MMC-I-Pad-base_GOVUK-FINAL_SECURE.pdf

However, there is no date at which change in construction methods became discernably "modern". Equally there is no moment when "traditional" methods of construction were abandoned. The concept is ahistorical, and lacks discretion in what is a technical progression or regression.

Procurement

The buyer of MMC must beware. Investors acting either as or through the client should not imagine the statutory guidance is sufficient or even applies to novel construction. *Caveat Emptor* always applies in the market, even though the mood at the Office for Product Safety and Standards (OPSS) may tend to encourage . A situation in which the seller of MMC must beware.

https://www.gov.uk/government/organisations/office-for-product-safety-and-standards

Modular example

This vexed question of whether the statutory guidance applies to novel construction is pivotal when considering Category 1 MMC "3D primary structural systems", as a Modular or Volumetric approach to building. For Permanent Stacked Modular Buildings, RISCAuthority published the IQ8 Questionnaire and the Technical Checklist as two related documents organised against the Schedule 1 Requirements of the Building Regulations 2010, as they were in 2021:

- IQ8 *Building system questionnaire: Permanent Stacked Modular Buildings – Interactive*
  https://www.thefpa.co.uk/resource-download/394
- IQ8 *Permanent Stacked Modular Buildings: Technical Checklist for England*
  https://www.thefpa.co.uk/resource-download/395

However, the CROSS Safety Report 1065 *Volumetric modular buildings and fire* published on 16 December 2021, which refers to the IQ8 Questionnaire and the Technical Checklist, takes the view that Modular may be outside the statutory guidance. CROSS 1065 says "... it can be argued that volumetric modular is not a common building situation, as it incorporates modern construction methods."

https://www.cross-safety.org/uk/safety-information/cross-safety-report/volumetric-modular-buildings-and-fire-1065

The CROSS consideration of "modern construction methods" as not a "common building situation" has more extensive implications for MMC providers and advocates. Surely not all MMC is uncommon. Much MMC is ubiquitous.

Unresolved issue

This matter is nowhere resolved by DLUHC as the Ministry, is outside the OPSS remit, and is not for CROSS to resolve. Furthermore, Mark Farmer as the lead author of the MMC framework appears not to have been asked to address it. This makes it impossible to say that the

Categories of MMC are addressed by statutory guidance in any of their Parts as BDM01-16. Reliance solely on BDM01-16 (E-AD-B) for a development judged by the client to be a "common building situation" not only disregards resilience but may not assure health and life safety.

Modular is considered further in Principle I, where compartmentation is addressed, and Principle J where cavities within compartment walls and floors is addressed.

Choose resilience

The approach taken in this document from Principle A is to encourage careful investment in a development project. To provide health and life safety but also resilience by design, construction and, after handover, management of the building in use for many years.

Handover moment

It is necessary to recognise the momentous importance of a successful handover as Work Stage 6 in the *RIBA Plan of Work 2020*.

Soft Landing

The idea of "soft landings" at handover has been well established in the building services sector, and is discussed further in Principle F. Soft Landing requires a building delivery approach that runs through the project Work Stages.

The Building Services Research and Information Association (BSRIA) Soft Landings Network was established in 2010 to support understanding of this process, promote its uptake across the industry, and ensure its continuous development.

https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/user-group/

https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/guides/

Hard Landing

The same can be said for designing out fire and water related hazards and managing the construction to avoid shocks to the project. A "hard landing" at development handover is to be avoided.

It is too late to discover an unexpected lack of resilience or unresolved hazards for health and life safety in design and construction when the "Responsible Person" is appointed by the building owner or operator under the Regulatory Reform (Fire Safety) Order 2005 at handover.

https://www.legislation.gov.uk/uksi/2005/1541/contents

Responsible Person

The appointment of the "Responsible Person" need not wait until Work Stage 6 handover, as is often the case. The "Responsible Person" may be appointed at any Work Stage before handover, to support the client. That support may be extended to the client's consultants and contractors through the design and construction Work Stages. However, that should be a voluntary arrangement.

Appointed proxy

Consequently Principle A involves the early appointment of a person as a proxy for the eventual "Responsible Person", without giving that appointee a title.

While the Regulatory Reform (Fire Safety) Order 2005 allows a legal person as a company to undertake the role of "Responsible Person", Principle A advises the appointment of a natural person by the client, to protect the investment. This is to encourage commitment to a natural person, given a title to suit the project.

Clerk of works

A clerk of works can be appointed. The Institute of Clerks of Works and Construction Inspectorate defines the role as "... a person whose duty is to superintend the construction and maintenance of buildings, or other works for the purpose of ensuring proper use of labour and materials."

https://www.icwci.org/

Compliance monitor

Consultants acting for the client during the construction phase are often instructed to provide a "resident" professional based largely on site, or perhaps a specialist compliance monitor, even during the design phase. Consultants may be co-located with contractors to assist communication and co-ordination.

These arrangements may not be sufficiently focused on the Resilience Strategy, or even the Regulation 38 Fire Safety Information exchange expected by the Building Regulations 2010. Effort must be made by the client to focus the attention of their consultants and contractors on achieving resilience by the time of handover.

Competence

Instead of clerk of works or compliance monitoring specialists to check design and construction, relevant to achieving Principles S, T and U, the achievement of Principle A in anticipation of Principle V requires a natural person with competence comparable to that expected of the "Responsible Person", to act as their proxy.

The Regulatory Reform (Fire Safety) Order 2005 does not define the competency of the "Responsible Person". The Health and Safety Executive (HSE) advises that competence "... can be described as the combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely." Adding that "...other factors, such as attitude and physical ability, can also affect someone's competence."

https://www.hse.gov.uk/competence/what-is-competence.htm

Definition required

The competency of the "Responsible Person", and therefore their proxy envisaged in Principle A, may yet be defined in future government or HSE guidance. Until that time the competency of the natural person as a proxy for the "Responsible Person" must remain a matter of judgement for the client, who may be risking their own finance or acting for other investors.

Vested interest

Investors have the vested interest in the competence of their appointees, following the decision to financially invest in a resilient asset that will be minimally damaged by fire or water, in addition to satisfying legal requirements for the health and life safety of anticipated building occupants.

Resilience Strategy

Principle A goes beyond health and life safety concerns. Briefing documents for resilience are developed through the design phase into a Resilience Strategy for events that can cause fire and water damage.

The Resilience Strategy with practical application to the project through the Work Stages is wider in scope than a Fire Strategy, which must contain an Evacuation Strategy. Reference to a Fire Strategy in the *RIBA Plan of Work 2020* is insufficient for Principle A if restricted health and life safety, as critically important as that is.

Investors in the private sector need to consider the resilience of their investment in buildings, but so should public sector managers of assets ultimately funded by taxation over time. Much guidance is in terms of "business", but public service providers are also able to consider themselves as enterprises with commercial aptitude in the market, needing insurance against fire and water damage.

Resilience guidance

In 2005 with a focus on the private sector the FPA and the Insurers' Fire Research Strategy (InFiReS) published *Business Resilience – A guide to protecting your business and its people*, which remains available on the FPA website.

https://www.thefpa.co.uk/resource-download/257

That early overview considered property protection and referred the reader to a series of Risk Control documents. By 2012 the International Organization for Standardization (ISO)

had published the first version of ISO 22301 *Business continuity management systems – Requirements*, as part of a "Societal Security" theme. This was replaced by BS EN ISO 22301 *Security and resilience. Business continuity management systems – Requirements* in 2014 and 2019. BS EN ISO 22313:2020 *Guidance on the use of ISO 22301* is now the starting point for the Business Continuity Solution Pack from the British Standards Institution (BSI).

https://knowledge.bsigroup.com/products/business-continuity-management-solution-pack

In response RISCAuthority published the updated and more focused *Fire Engineering Guide for Property Protection and Business Resilience 2020*.

https://www.thefpa.co.uk/resource-download/392

Fire Engineering

RISCAuthority sought to encourage use of BS EN ISO 22313 in combination with BS 7974:2019 *Application of fire safety engineering principles to the design of buildings. Code of practice*. The BSI standard for fire safety engineering requires a Qualitative Design Review (QDR) addressed through a framework of Published Documents PD 7974, in seven Parts:

1 Initiation and development of fire within the enclosure of origin;

2 Spread of smoke and toxic gases within and beyond the enclosure of origin;

3 Structural response and fire spread beyond the enclosure of origin;

4 Detection of fire and activation of fire protection systems;

5 Fire service intervention;

6 Evacuation;

7 Probabilistic fire risk assessment

Order of control

Resilience is considered in terms of susceptibility, vulnerability, and recoverability, all of which can be influenced by the application of fire engineering methods.

Avoiding a fire starting (susceptibility) will always give a greater reward than measures designed to control a fire once it has started.

Measures that limit fire spread (vulnerability) will always give greater reward than measures designed to recover what is lost (recoverability).

Fire Engineering Guide for Property Protection and Business Resilience 2020 provides an order to the application of control measures to be discussed with insurers and the Fire and Rescue Service.

Susceptibility

Avoidance of fire and water perils will always give a greater reward than measures designed to control those events. Susceptibility is addressed by reducing the probability of financial loss from a fire or water event.

Avoid fire and water related perils being an issue. This is achieved by avoiding sites and building forms that are susceptible to flooding, by building with materials that are not ignitable, cannot support combustion, and are unaffected by water, or by reducing dependency on human actions and interventions, for example.

Facilities management can be anticipated to reduce susceptibility in the Resilience Strategy. Measures that assist management later may include capability duplication, separation in other premises, and continuity plans that allow activities to move to other premises prepared for such an eventuality. Investment in prevention measures can reduce the probability of fire occurring. Knowing about, assessing, and maintaining key facilities is important.

D	Maximise Non-Combustibility	2 Prevent Fire Starting
E	Anticipate Arson Attempts	
F	Monitor Building Services	

V	Verify Recorded Information	6 Improve Facilities Management
W	Manage Fire Safety	

Vulnerability

Measures that reduce fire and water damage will always give a greater reward than measures designed to recover what is lost. Vulnerability is addressed by reducing the impact of any fire or water event.

Reduce the extent of damage following a fire or water related event by building in measures. This is achieved by locating critical systems above the maximum flood level, by providing compartmentation and sprinkler protection, waterproofing and safe-passage water drainage systems, or by installation of reliable detection and alarm systems, for example.

Investment in the quality of passive fire protection, through testing, procurement, and competent work on site, is a valuable commitment. Such protection includes in fire-resistant compartment floors and walls, the fire doors, fire shutters and fire curtains relating to them, and the fire stopping of building services penetrating them.

Combined with investment in active fire suppression to LPC Sprinkler Rules, the adoption of measures in BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022 will reduce the vulnerability of the building interior to fire events.

https://www.thefpa.co.uk/resource-download/405

G	Address Occupational Issues	3 Lower Property Loss
H	Extend Structural Stability	
I	Reduce Fire Severity	
J	Control Compartment Cavities	
K	Separate External Openings	
L	Resist Fire Ingress	
M	Expect Adverse Weather	
N	Minimise Consequential Damage	

The architectural form and fenestration affects external vulnerability as Principle K, even when avoiding the susceptibility of the external wall to fire by maximizing non-combustibility as Principle D. Water management should be an aspect of the external wall and roof, but weather related events are not the only water related events that concern insurers. Internal escape of water is a costly vulnerability.

Consequential damage from water, which may be necessary in firefighting, is a vulnerability of concern to insurers. So too is construction that cannot be simply repaired following fire, heat, smoke, and water damage.

O	Facilitate Simple Repair	4 Enhance Design Robustness
P	Plan Salvage Operations	
Q	Follow Identified Standards	
R	Provide Reliable Detection	

Communication with the Fire and Rescue Service will assist them in attending to and extinguishing a fire, even though their duty is to the life safety of occupants, the public, and operational firefighters. The planning of salvage operations with the Fire and Rescue Service is of great importance, particularly when valuable vulnerable contents can be saved, as with Museums, Libraries, Art Galleries and Heritage buildings. Unreliable detection is obviously a vulnerability.

S	Complete Performance Tests	5 Check Construction Achieved
T	Procure Quality Materials	
U	Require Competent Work	

Failure to check the construction achieved is an entirely avoidable vulnerability.

Recoverability

Operational interruption for any organisation, whether institutional or commercial, is best minimised in the design and construction of the building against the prospect of fire and water damage. Recoverability is addressed by facilitating financial support through insurance measures, good relationships with the constituency of "Relevant Persons" as Principle G, and facilities management planning in which rehearsals are undertaken.

Improve the rapid recovery to full capability following fire and water related events. This is achieved by consultation with insurers and the Fire and Rescue Service, through training in fire safety or escape of water incidents, and through business continuity planning that involves facilities management, for example.

B	Engage Insurers Early	1 Undertake Early Consultation
C	Support Firefighting Operations	

Where damage to the property has been minimised by avoiding susceptibilities and reducing vulnerabilities, prompt recovery from fire will be more easily achieved by the facilities managers if they have prepared for reasonably foreseeable events.

W	Manage Fire Safety	6 Improve Facilities Management
X	Action Statutory Assessments	
Y	Keep Maintenance Commitments	
Z	Critically Review Experience	

The British Damage Management Association (BDMA) established in 1999 publishes *BDMA Standards – Guidelines relating to the protocols and procedures for dealing with incidents or perils that damage properties*.

https://bdma.org.uk/standards/bdma-standards/

Reference should also be made to:

- BS 12999: 2015 *Code of practice for the organization and management of the stabilization, mitigation and restoration of properties, contents, facilities and assets following incident damage*
- PAS 64:2013 *Mitigation and recovery of water damaged buildings. Code of practice*

The ongoing effort to achieve resilience is a dialogue between facilities managers appointed by building owners or operators and their insurers in an existing building, which the initiating investor must establish in any new building.

Complexity

BDM01-16 (E-AD-B) in both Volume 1 for Dwellings, which includes Flats, and Volume 2 for Buildings other than dwellings, recognises that fire safety engineering "... may be the only practical way to achieve a satisfactory standard of fire safety in some complex buildings and in buildings that contain different uses".

The use of "simple" is not stated to be the meaning of the limitation in the statutory guidance to "common building situations". Complex and Mixed Use buildings are common, but suggested for a fire engineering approach.

Purpose Groups

Table 0.1 Purpose Groups in both Volumes of (E-AD-B) only considers single use buildings. Mixed Use buildings of greater complexity may therefore need to be designed and built using a fire safety engineering approach. Table 0.1 provides the Purpose Group structure for both BDM01 and BDM02, and occupational issues are further considered as Principle G.

An attitude that encourages resilience involves the investor appreciating the needs of the occupants of the proposed building, and how it will be used.

Speculative residential development not retained by the investor acting either as or through the client as an asset does not preclude the pursuit of resilience. The individual occupants of the future may not be known in speculative development but user needs for property protection beyond their health and life safety can be anticipated. In many refurbishments of occupied buildings, the residents are available to be known as people, with shared and individual aspirations.

Natural persons

Grenfell Tower Inquiry and the resultant discovery of widespread deficiencies in the built stock has focused attention on residents of Flats in particular. New democratic ways to undertake Principle A need to be developed where a population of residents as natural persons, whether Leaseholders and Tenants, are having their homes refurbished by the legal persons of Freeholders or Landlords.

It should be remembered that health and life safety applies to natural persons, but they too will benefit from more resilient building design and construction.

Popular expectation

Many residents will probably expect that they may evacuate the building without threat to their health and life safety, with their personal possessions being protected from a fire or water related event in neighbouring Flats. They will expect that the compartmentation of the Flat will hold internally, and the fire will not spread externally through the external wall construction. They will probably expect fire, heat, smoke, and water damage will be contained, and brought under the control of the Fire and Rescue Service. So that after firefighting intervention the Fire and Rescue Service may confirm that the fire was extinguished, and they may return to unaffected homes while cleaning up and repair is started. That popular expectation of resilience is reasonable.

However, this reasonable popular expectation of resilience is not provided by the Building Regulations. The only aspect that the law addresses is that residents must be able to evacuate the building without threat to their health and life safety. The Fire and Rescue Service are further expected to not put the health and life safety of their firefighters at risk, and cannot guarantee a compartment fire will be extinguished before it involves other compartments, or the whole building.

Owners of the Freehold of Flats and Landlords collecting rents from Tenants are grappling with the lack of resilience in the "life safety before collapse" objective of building legislation. So too are Leaseholders and Tenants as residents, particularly in those Blocks of Flats that require remedial works for fire safety. New democratic ways to address resilience for residents are necessary, and that is a far different question to the concern a Freeholder or Landlord has for their business resilience.

Professional effort

It is likely that legal persons have to present more personally as professionals to the natural persons they hope to convince about health and life safety and their reasonable expectation of resilience. Managing down reasonable expectations of resilience is not going to result in a democratic outcome for residents. The dismissive idea that Tenants should be grateful for what they are provided with may not survive the Grenfell Tower fire, the Grenfell Tower Inquiry, and the prosecutions that will follow the final Report from Martin Moore-Bick. This shift is further discussed in relation to the Evacuation Strategy in Principle C.1, and when addressing occupational issues as Principle G.

Professional tasks

There also needs to be further thinking about Principle A.6 and the coherence of the project documents. Principle H considers the importance of the Movements and Tolerances Report as a contract document, and how that will be produced as a professional effort. Principle S considers the discipline of Strategy, Testing, Inspection, Certification, and Compliance (STICC).

This may appear to be a great effort for investors acting either as or through the client to think about strategically from Work Stage 0. However they have the whole project programme to make sure their strategic investment results in a successful project outcome. That is a building that is resilient while attending to health and life safety.

Training

The Cabinet Office supports the Emergency Planning College (EPC) who may provide training for those engaged in preparing a Resilience Strategy.

https://www.epcresilience.com/what-we-do/specialisms

10.2 Principle B – Engage Insurers Early

Principle B – Engage Insurers Early

Engage with professional indemnity, construction, defects, building, and contents insurers from the earliest Work Stage in project planning, to interrogate the value of the Essential Principles and optimise the insurability of the building in use.

B.1 Insurers have been consulted on project resilience as Principle A.2

B.2 Consider fire engineering the whole building to BS 7974 *Fire Safety* series

B.3 Adopt BDM02 *Compartmentation and Sprinkler Rules* Version 2 – 2022

B.4 Insurers are consulted on external protected zones

B.5 Insurers are consulted on combustibility and smoke toxicity

B.6 Insurers provide guidance to clients on third party schemes as Principle U

B.7 Duties under Construction (Design and Management) Regulations 2015

B.8 Comply with FPA *Fire Prevention on Construction Sites* 10th Edition: 2022

B.9 Necessity for working at height is either designed out or risk managed

B.10 Insurers are invited to witness performance testing as Principle S.9

B.11 Service Life Planning as Principle O with inspection and maintenance

B.12 Insurers are informed of non-compliances as Principle A.8

B.13 Fire Safety Information and Building Manual on request as Principle V.13

B.14 Demonstration that maintenance commitments are kept as Principle Y

B.15 Building owners or operators periodically meet for review as Principle Z

Insurer relationship

It is not always obvious to the client how they are to engage with insurers early in a project. Investors with a track record of development and property ownership have established relationships with preferred insurers competing in the market.

There is a need for insurers to make themselves approachable by and available to new and established customers.

Associations

The Association of British Insurers (ABI) represents the insurance and long-term savings sector in the UK market. The ABI encourages investors acting either as or through the client to engage with insurers early in any development project.

https://www.abi.org.uk/products-and-issues/topics-and-issues/buildings-blueprint/

https://www.abi.org.uk/about-the-abi/about-us/

The British Insurance Brokers' Association (BIBA) is the leading UK general insurance intermediary organisation. Insurers who do not already have a relationship directly with investors, the client, and the consultants, contractors and facilities manager who come to work for them, may be approached through an insurance broker. For some development projects, that may mean identifying a specialist insurance broker who can act as an intermediary.

https://www.biba.org.uk/

Insurance market

A useful introduction to how the insurance market works is provided by Lloyd's.

https://www.lloyds.com/about-lloyds/our-market/how-insurance-works

Several forms of insurance are needed, while Building Insurance is most directly related to the prospect of fire and water damage:

- Professional Indemnity
- Construction or "Contractor All Risks"
- Public Liability
- Defects Liability
- Building
- Contents
- Business Interruption
- Employer's Liability

JCoP 2022

On construction projects with an original contract value of over £2,500,000 the RISCAuthority, FPA and Contractors Legal Group (CLG) publication *Fire Prevention on Construction Sites: The Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation* – 10th Edition: August 2022 is to be complied with, in consultation with construction phase or "Contractor All Risks" insurers as Principle B.8. The *JCoP on Fire Prevention on Construction Sites* was first published in 1992. This is free to download in pdf form and is accompanied by a checklist. Projects of smaller contract value are also encouraged to follow the JCoP guidance.

https://www.thefpa.co.uk/resource-download/607

If compliance with the *JCoP on Fire Prevention on Construction Sites* 2022 forms part of the insurance contract, non-compliance could result in insurance ceasing to be available or being withdrawn, resulting in a possible breach of a construction contract which requires the provision of such insurance.

HSE HSG 168 2022

The *JCoP on Fire Prevention on Construction Sites* 2022 applies to activities carried out prior to and during the procurement, construction and design process – not the completed structure – and should be read in conjunction with all current legislation and the Health and Safety Executive (HSE) HSG 168 *Fire safety in construction* – Third Edition published July 2022. HSE HSG 168 2022 is referenced in Principle V, and applies pre-construction during the design phase.

https://www.hse.gov.uk/pubns/books/hsg168.htm

CLG advice

Established in 2009, the Contractors Legal Group (CLG) is a legal and contractual advisory company for contractor trade associations within the construction industry, working closely with the Joint Contracts Tribunal (JCT). CLG is supported by Build UK, the National Federation of Builders (NFB), the Scottish Building Federation (SBF), and the National Access and Scaffolding Confederation (NASC).

https://www.clgcontractors.com/

Investor leadership

Investors lead by determining and defining the resilience they expect for their investment as Principle A. Buildings that lack resilience may still be insurable, but the cost of insurance will be higher. If known hazards of fire and water damage at the scale of the project present an extremely high risk of financial loss, the investment may be uninsurable. The insurance market is highly competitive, but there are insurers who will have an appetite for high risk projects because the insurance premiums are expensive. Some high risk developments are commercially viable despite high cost insurance because rent or resale values make the insurance a marginal consideration.

However, it must be remembered that the risk of fire and water damage shall not be to health and life safety, only to property.

Planned prevention

It is too late to discover that insurance is prohibitively expensive or unavailable late in the *RIBA Plan of Work 2020*, resulting in the need for a serious project rethink.

That is particularly so after any planning approval has been obtained for the client and it becomes difficult to apply for amendments through "Reserved Matters" under the delegated powers of Planning Officers in local authority planning departments. A reapplication for an alternative design may be politically awkward for landowning investors acting either as or through the client and may cause them to question their consultants about abortive work. Planning approvals have great commercial value and their achievement represents an investment.

The most significant or consequential design decisions need to be taken before a planning application is made. Technicalities can be drawn out later in the *RIBA Plan of Work 2020*, but some conceptual issues need to be confronted. Thinking about ways to prevent fire starting with insurers will assist the client to improve the resilience of the design before an expensive public planning application.

Negotiation

None of the A to Z of Essential Principles are imperatives or absolutes. They cannot be enforced by insurers. That is not how insurance works. A commercial negotiation on insurance is always possible.

For example, insurers recognise that local and national planning policies often encourage combustible construction methods. Additionally, the power to make Building Regulations is currently exercised by the Secretary of State of DLUHC, as established in Section 1 of the Building Act 1984.

https://www.legislation.gov.uk/ukpga/1984/55/section/1

Environmentalism

After health and life safety in Section 1(1)(a) of the Building Act 1984, the power to make Building Regulations is extended for the purposes of:

(b) furthering the conservation of fuel and power

(d) furthering the protection or enhancement of the environment

(e) facilitating sustainable development

These purposes are given practical meaning throughout the statutory guidance as discussed as BDM01-5. Together with environmentally framed local and national planning policies, the wider purposes of the Building Regulations and statutory guidance approve the market for combustible construction methods, products, and systems for energy efficiency, environmental, or sustainability purposes.

There is competition to advocate "Green" MMC, though no proposed innovation in eco-construction is acceptable in buildings when known to be injurious to human health and life safety, whether in a non-fire or fire situation.

Principle D choices

Principle D.1 favours non-combustible construction, supported by Principles D.4, D.5, D.6, D.9, D.11 and D.12. However there is always a commercial negotiation in Principle B. The choice of combustible construction can be preferred by investors acting either as or through the client, sometimes accepting higher construction costs that exceed marginal insurance costs. This may be for any reason agreed with the insurer subject to health and life safety legislation, as Principle D.2. The decision to invest in combustible materials is made amid competing claims of carbon emissions reductions, justified in the aggregate as a contribution to a reversal of Climate Change, which is understood as "Global Warming" notably through the atmospheric "greenhouse effect".

Industry leadership

Considerable effort goes into calculating carbon emissions prior to a planning application around Work Stage 3. Carbon reduction in structural design is a focus for all trade

associations in the concrete, steel, and timber sectors, with structural engineering and architectural practitioners competing to innovate throughout the building fabric. Environmental Product Declarations (EPDs) are produced to BS EN 15804:2012+A2:2019 *Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products*. The EPD will be defined with a "boundary" for measurement in phases known as:

- Cradle-to-Gate
- End-of-Life
- Cradle-to-Grave

Only the Cradle-to-Grave type EPD includes the whole life-cycle of a construction product, including its maintenance as Principle Y. Some durable products have a longer service life than others, requiring Service Life Planning as Principle B.11.

Some manufacturers like to market their products on the Cradle-to-Gate type of EPD, which should not be used for comparison. As with the partial End-of-Life measurements, the Cradle-to-Gate measure gives a false impression of carbon emissions. Some products involve higher carbon emissions in manufacture than others, but over a whole life-cycle a more realistic view will be presented.

To assess timber for End-of-Life would show high carbon emissions, which is why some manufacturers claim "circularity" in the economy as recycling, which may never occur in commercial reality. To only assess manufactured brick, concrete, and steel from Cradle-to-Gate puts them at a disadvantage compared to timber as a harvested crop sequestering carbon in the growing process. It is important to obtain an "apples-for-apples" comparison between products if carbon emissions are considered decisive. Not to do so is a marketing pitch in short-term policy.

Circular economy

The European Commission published *Circular Economy – Principles for Building Design* in 2020. The EC focus is on durability, adaptability, and waste reduction in manufacture and construction, backed with high-quality waste management.

https://ec.europa.eu/docsroom/documents/39984/attachments/1/translations/en/renditions/native

Proposed Part Z

There is an industry-proposed amendment to Schedule 1 of the Building Regulations 2010 in Part Z for "Whole Life Carbon". It may come to insist upon the comparative Cradle-to-Grave approach to EPDs, which might make it unpopular with manufacturers preferring a partial view of carbon emissions. Alternatively, Part Z may admit non-comparative measurements as BS EN 15804.

https://part-z.uk/

Attention on the external wall has encouraged the Centre for Window and Cladding Technology (CWCT) to publish *How to calculate the embodied carbon of façades: A methodology*, Issue 1 in September 2022.

https://www.cwct.co.uk/collections/sustainability/products/how-to-calculate-the-embodied-carbon-of-facades-a-methodology

Sustainability

The CWCT established a Sustainability Committee in 2019 and published their *Sustainability Guide 01 An Introduction to Sustainability in Façades* in October 2021. The CWCT provides a useful curated page of links to other guidance.

https://www.cwct.co.uk/pages/sustainability-1

https://www.cwct.co.uk/pages/external-guidance

The concern for sustainability is wider than carbon emissions, as discussed further in Principle Z. There is an obvious tension between the selection of organically grown but nevertheless industrially processed materials, such as timber, and the preference for

non-combustible materials as Principle D that require significant energy in their industrial extraction and manufacture. Anticipation of arson attempts in Principle E largely depends on selection of non-combustibility in Principle D. There are also significant questions of sustainability in the operation of building services systems, affecting the choices made early in Work Stage 2 Concept Design. The choice of building services profoundly affects later Work Stage 3 Spatial Coordination. These three aspects require early consideration as Phase 2 in the *A to Z of Essential Principles*.

D	Maximise Non-Combustibility	2 Prevent Fire Starting
E	Anticipate Arson Attempts	
F	Monitor Building Services	

Of course building services considerations are not only about fire starting. Water consumption is a sustainability concern, and water damage is revisited in Principle N consequential damage and Principle O simple repair, in Work Stage 4 Technical Design. The early Principles D, E and F have impact on later design development.

Insurer terms

Insurers will take a competitive view on the decision to invest in combustible materials as Principle D.2. The insurance sector has varying terms, definitions, and methodologies for damage and interruption loss estimations. Each insurer in the market has methods for reasoned and consistent fire loss scenarios and damage evaluations that can be routinely applied to develop loss estimates, which align with definitions from the Association of British Insurers (ABI). The loss estimate terms used by the ABI and insurers are:

- Normal Loss Expectancy NLE Best case
- Estimated Maximum Loss EML Adverse conditions
- Maximum Foreseeable Loss MFL Worst case

A difference between NLE and EML may be when sprinklers are not working as intended. Since effort is put into the maintenance of sprinkler systems installed to the LPC Sprinkler Rules, this rare occurrence can be factored into the loss estimation process that all insurers undertake in the market.

Concessions

An obvious example of a low impact use of combustible materials in a fire event is the flat roof waterproof membrane which, if designed and built well, promises to be a weathering against water damage. Applied over a non-combustible flat roof deck and covered with non-combustible materials for ballast, such as paving and gravel, combustible waterproof membranes present little fire risk for the insurer.

Pre-planning

Only through consultation with insurers as Principle B, before embarking on detailed carbon calculations and prior to any planning application, will investors know how the proposed development will be priced for insurance. Only through full disclosure will the risk be accurately priced with precise terms and conditions.

Memberships

RISCAuthority membership covers 90% of the UK commercial insurance market and does not have a wider membership scheme. RISCAuthority members are insurers but much guidance is published freely to non-members. Combustible construction is insurable, though some MMC risks being uninsurable. The buildings that maximise non-combustibility will generally cost less to insure.

https://www.thefpa.co.uk/membership/riscauthority-membership

Established by the ABI in 1946 to be the voice of fire safety for the Fire Offices' Committee (FOC), the Fire Protection Association (FPA) has a wider membership scheme as the UK leading fire safety organisation. The FPA is committed to setting the highest industry standards, influencing policy, and supporting members with comprehensive fire safety

news, advice, training, resources, and benefits. FPA members enjoy discounts on important industry publications such as the LPC Sprinkler Rules.

https://www.thefpa.co.uk/membership

Core Document

While RISCAuthority publication BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022 is to be read with BDM01, and both are freely available, the LPC Sprinkler Rules have a price. It is wise for investors acting either as or through the client to appreciate the value to insurers of investment in fire resisting compartmentation to BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*, and the advantage in different Purpose Groups when sprinklers are installed to LPC Sprinkler Rules. The reader of BDM01 will refer to BDM02.

Purpose Groups

BDM02 is based in the Purpose Groups that are considered in Principle G. The fire resistance for structure as Principle H and for compartmentation in Principle I are tabulated by Purpose Group and height of building. In this way BDM02 addresses Principles G, H and I as an aspect of Phase 3 in the *A to Z of Essential Principles*.

Principles H and I relate to whether compartment walls and floors are of solid construction, or contain cavities, discussed as Principle J. Principles H and I begin to discuss the advantage of fire resisting protected zones in the roof and the external wall, which are related to concerns in Principle K about separation between openings in the external wall, and in Principle L for separation between buildings. The ability of burning brands to be blown by the wind and the spread of fire by radiation are both due to building proximity. Together these are Phase 3 issues that tend to vary according to Purpose Groups.

G	Address Occupational Issues	3 Lower Property Loss
H	Extend Structural Stability	
I	Reduce Fire Severity	
J	Control Compartment Cavities	
K	Separate External Openings	
L	Resist Fire Ingress	

As design development enters Work Stage 4 Technical Design considerable thinking has been devoted to statutory matters of health and life safety.

CDM 2015

Insurers understand and expect that the client, with their consultants and contractors, will comply with the statutory requirements of the Construction (Design and Management) Regulations 2015, as guided by the Regulator.

www.legislation.gov.uk/uksi/2015/51/contents

The Health and Safety Executive (HSE) is the Regulator for CDM 2015.

www.hse.gov.uk/construction/cdm/2015/index.htm

HSE publication L153 *Managing health and safety in construction – Guidance on Regulations*, published in 2015, provides guidance on the law that applies to the design and construction Work Stages, and what each duty holder shall do.

www.hse.gov.uk/pubns/priced/l153.pdf

The HSE provides a summary of duties under CDM 2015, for the client as the building owner or building operator, and for the "Principal Designer" and "Principal Contractor", who shall manage all sub-contractors.

www.hse.gov.uk/construction/cdm/2015/summary.htm

CDM 2015 File

CDM 2015 is a process focused on the Health and Safety File. This iterative document is developed by the "Principal Designer" to become part of the Employer's Requirements at tender. The CDM 2015 Health and Safety File is developed and responded to by the "Principal Contractor", who provides the residual document to the client at handover in Work Stage 6. Thereafter, the facilities manager takes on statutory duties for health and life safety in the occupied building.

The CDM 2015 Health and Safety File is offered for the client's acceptance at handover, with a different purpose to the Regulation 38 Fire Safety Information exchange and the contracted Building Manual. Guidance is widely available.

RIBA Practical Guide

In 2015, the RIBA published *CDM 2015 – A Practical Guide for Architects and Designers* by Paul Bussey. This has been reprinted several times through to 2019.

https://www.ribabooks.com/CDM-2015-A-Practical-Guide-for-Architects-and-Designers_9781859466131

ICE Practical Guide

The Institution of Civil Engineers (ICE) published a *Practical Guide to Using the CDM Regulations 2015: Teamwork not paperwork* in 2015, by Tony Putsman and Paul McArthur.

https://www.icebookshop.com/product/practical-guide-to-using-the-cdm-regulations-2015-teamwork-not-paperwork

Tony Putsman and Paul Bussey maintain the "CDM Differently" website.

https://www.cdmdifferently.com/

Lead Designer

The role of "Lead Designer", appointed by Work Stage 3 from among several consultants employed by either the client or the contractor, is not to be confused with the statutory role of "Principal Designer" under CDM 2015. However, they can often be the same consultant. The "Principal Contractor", from the point of view of CDM 2015, may be subsequently appointed as the "Lead Designer".

Full disclosure

Insurers who have been consulted early will continue to be available to the client and want to be kept informed. Those insurers who receive full disclosure will be engaged through the Work Stages, while respecting contractual relationships between the client and their consultants and contractors.

Peter Baker's BSR

The government has appointed HSE to establish a new Building Safety Regulator (BSR) following the Grenfell Tower fire. Peter Baker as Chief Inspector of Buildings is establishing the BSR. The BSR will then become the building control inspector for high-rise buildings, of seven or more storeys or that are >18m high, provided they have either:

- at least two Residential units; or
- are Hospitals or Care Homes.

The role for insurers is not diminished by the HSE as the BSR. It remains important to make the case for an investor led Resilience Strategy that an insurer will value in addition to the considerations of health and life safety for which the BSR is involved. The Evacuation Strategy developed as part of the Fire Strategy with the Fire and Rescue Service as Principle C.1 is important, but the Resilience Strategy will address issues that the BSR has no power to determine.

https://www.hse.gov.uk/building-safety/index.htm

Practical life safety

While insisting on the narrow legal meaning of "reasonably practicable", the HSE variously uses the principles of:

- ALARP – "as low as reasonably practicable"; and
- SFARP – "so far as reasonably practicable".

https://www.hse.gov.uk/managing/theory/alarpglance.htm

https://www.hse.gov.uk/managing/theory/index.htm

The legal definition of "reasonably practicable" was established in *Edwards v. National Coal Board, [1949] 1 All ER 743*, and informs the Health and Safety at Work etc. Act 1974. The pursuit of health and life safety is not an absolute.

https://www.legislation.gov.uk/ukpga/1974/37/contents

Practical resilience

The pursuit of resilience for insurance is neither unreasonable nor impractical.

While pursuing resilience in asset or property protection, in addition to health and life safety, BDM01 has similarly adopted "so far as reasonably practicable", only occasionally resorting to the acronym SFARP.

That principle of "reasonably practicable" shall not be used as an excuse for poor strategic planning, design, construction, maintenance, or management across the Work Stages in the *RIBA Plan of Work 2020*.

Working at height

Principle B.9 is an example of where being "reasonably practicable" becomes important. The necessity for working at height can be either designed out or risk managed "so far as reasonably practicable", particularly when considering roofs and external walls with their geometry of recesses and projections.

External access at height is of great importance through the construction phase for CDM 2015. It is important for simple repairs as Principle O, for inspections as Principle X, so that statutory assessments can be carried out and acted upon, and for keeping maintenance commitments as Principle Y. External access at height for cleaning is often neglected.

Safe access to the roof and external wall requires strategic attention. It is not always possible to access a convoluted external envelope, with projections and recesses in the external wall, perhaps related to balconies as attachments. The impracticality of roof and external wall access should not be designed into a building. Reference shall be made to BS 8560:2012+A1:2018 *Code of practice for the design of buildings incorporating safe work at height*.

Firefighting at height

The Fire and Rescue Service will also have operational insight into the way the architectural form and fenestration, in addition to the detail of the construction, affect their ability to fight a fire at height, as Principle C.14.

Conceptual design

The question of working at height in a non-fire situation, and the question of firefighting at height in a fire situation, both need to be addressed in the conceptual design of Work Stage 2.

JCoP 2022

Early reference by the "Lead Designer" and the "Principal Designer" to the *JCoP on Fire Prevention on Construction Sites* 2022 may be encouraged by the client, and not deferred to the "Principal Contractor". The JCoP may frame some of the CDM 2015 Health and Safety File considerations in terms insurers and contractors will appreciate. The minds of consultants should be focused on the ways in which the project may be constructed and how the works themselves need to be factored into the Resilience Strategy they are contributing to.

Service life

The anticipated design life of the building requires an understanding of the service life of the construction, which requires maintenance as Principle Y. All consultants and contractors should take an interest in BS ISO 15686-1:2011 *Buildings and constructed assets. Service life planning. General principles and framework*.

The Specification at tender should be clear about component service life and the maintenance commitment that is being designed into the project. The tenderers should insist on that clarity and should not be vague in their tender submissions about how they will deliver on the Resilience Strategy.

Effectiveness

The National Fire Chiefs Council (NFCC) and the National Fire Sprinkler Network (NFSN) published *Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom: An Analysis from Fire Service Data* in May 2017.

https://www.nationalfirechiefs.org.uk/write/mediauploads/nfcc%20guidance%20publications/protection/optimal_sprinkler_report.pdf

Sprinklers control fires in 99% of the 94% of cases when they work as intended. Sprinklers are highly effective at suppressing fires but cannot guarantee the fire will be extinguished. Fire severity in a compartment is reduced as Principle I.

Interruption costs

The benefits of investing in a system to the LPC Sprinkler Rules are likely to be confirmed in discussion with the insurer as Principle B and the Fire and Rescue Service as Principle C. Interruption from an event may have a greater cost than the damage to the building construction and contents. There are not simply financial costs but other consequential impacts to be considered.

Estimation of the business discontinuity costs during the period of reinstatement may be a significant part of the potential loss identified in the development of a Resilience Strategy as Principle A.

10.3 Principle C – Support Firefighting Operations

Principle C – Support Firefighting Operations

Consult with the Fire and Rescue Service to facilitate operations in pursuit of life safety with an emphasis on timely self-evacuation, understanding that rescue is a statutory obligation, but protection of the asset requires additional measures.

C.1 Evacuation, Fire, and Resilience Strategies for the Fire and Rescue Service

C.2 Consider fire engineering the whole building to BS 7974 *Fire Safety* series

C.3 Adopt BDM02 *Compartmentation and Sprinkler Rules* Version 2 – 2022

C.4 Fire and Rescue Service is consulted on external protected zones

C.5 Fire and Rescue Service is consulted on combustibility

C.6 Salvage is planned with the Fire and Rescue Service as Principle P

C.7 Basements are addressed for means of escape and firefighting operations

C.8 Storage and Car Parking, with other vehicular access not in BDM02

C.9 Provision of protected escape stairs with evacuation and firefighting lifts

C.10 Provision of protected lobbies to escape stairs with rising mains

C.11 Provision of water mains adjacent to rising mains accessible off the street

C.12 Provision of sprinkler mains accessible off the street

C.13 Correction factor for the number of compartments involved at any one time

C.14 Necessity for firefighting at height is either designed out or risk managed

C.15 Smoke control to maintain clear escape routes in the Evacuation Strategy

C.16 Smoke ventilation design anticipates unfortunate high wind pressures

C.17 Smoke leakage and toxicity in both construction and contents considered

C.18 Materials for construction producing toxic smoke are designed out

C.19 Fire and Rescue Service witnesses performance testing and receives reports

C.20 Integrated detection and alarm system for the Evacuation Strategy

C.21 Contingency planning in consultation with the Fire and Rescue Service

C.22 Fire and Rescue Service is informed of non-compliances as Principle A.9

C.23 Demonstration that maintenance commitments are kept as Principle Y

C.24 Building owners or operators periodically meet for review as Principle Z

C.25 Fire and Rescue Services Act 2004 and NFCC *National Operational Guidance*

C.26 Measures provide time to extinguish the fire beyond Evacuation Strategy

Fire Service history

The early role of insurance companies in the establishment of regional Fire and Rescue Services is articulated by Brian Wright in his informative *Insurance Fire Brigades 1680–1929: The Birth of the British Fire Service*, 2008.

However, there is no unitary "British Fire Service", but rather a federation of civil Fire and Rescue Services, with specialised aviation and military organisations.

Organisation

The Northern Ireland Fire and Rescue Service (NIFRS) has been a single emergency service since 1950, and currently operates to the Fire and Rescue Services (Northern Ireland) Order 2006.

https://www.legislation.gov.uk/nisi/2006/1254/contents

https://www.nifrs.org/

In Scotland, the Police and Fire Reform (Scotland) Act 2012 created a single Scottish Fire and Rescue Service (SFRS).

https://www.legislation.gov.uk/asp/2012/8/contents

https://www.firescotland.gov.uk/

In England and Wales, the Fire and Rescue Services are organised regionally under the National Fire Chiefs Council (NFCC), and there are additional commercial aviation and Defence Fire and Rescue Services.

https://www.nationalfirechiefs.org.uk/Fire-and-Rescue-Services

Purpose of service

Section 7 Firefighting of the Fire and Rescue Services Act 2004, that applies to England and Wales, appears to allow for property protection when it states:

(1) A fire and rescue authority must make provision for the purpose of:

  (a) extinguishing fires in its area, and

  (b) protecting life and property in the event of fires in its area.

(2) In making provision under subsection (1) a fire and rescue authority must in particular:

  (a) secure the provision of the personnel, services and equipment necessary efficiently to meet all normal requirements;

  (b) secure the provision of training for personnel;

  (c) make arrangements for dealing with calls for help and for summoning personnel;

  (d) make arrangements for obtaining information needed for the purpose mentioned in subsection (1);

  (e) make arrangements for ensuring that reasonable steps are taken to prevent or limit damage to property resulting from action taken for the purpose mentioned in subsection (1).

https://www.legislation.gov.uk/ukpga/2004/21/section/7

Property protection

Section 7 of the Fire and Rescue Services Act 2004 does not give power to English and Welsh Fire and Rescue Services to insist upon building resilience to achieve more than the "life safety before collapse" objective of building legislation. The Fire and Rescue Services cannot insist that buildings are built to be more resilient to assist them to make provision for the purpose of "... protecting property in the event of fires". Neither does the secondary legislation of the Regulatory Reform (Fire Safety Order) 2005 give powers to protect property by building design and construction. The consultation on that arrangement in 2020 has not resulted in a challenge to the health and life safety basis of the Building Act 1984 and Building Regulations 2010, discussed as BDM01-5.

https://www.gov.uk/government/consultations/fire-safety

Nevertheless the Fire and Rescue Services do their best to extinguish fires and limit damage in the process of firefighting, while "... protecting life", including their own health and life safety. There are considerable challenges in doing that job.

Firefighting as a job

The Health and Safety at Work etc Act 1974 applies to all activities of Fire and Rescue Services as the employers of staff. The HSE recognises that firefighters face moral dilemmas and make decisions in hazardous, emotionally charged, and fast moving situations. In 2010, the HSE published *Striking the balance between operational and health and safety duties in the Fire and Rescue Service*.

https://www.legislation.gov.uk/ukpga/1974/37/contents

https://www.hse.gov.uk/services/fire/duties.pdf

Operational guidance

NFCC *National Operational Guidance* (NOG) is available to be referred to by clients, building owners or operators to better understand the challenges facing Fire and Rescue Service operatives. The NFCC NOG is accessible. Investors acting either as or through the client can encourage the Fire and Rescue Service by making it easier for them to extinguish fires with less risk to occupants or themselves.

https://www.ukfrs.com/nog

Regional variations

The job of firefighting depends upon a complex division of skilled and experienced labour, the resources available to the Fire and Rescue Service, and the range of challenges faced in their region. Regions face different challenges, with the London Fire Brigade (LFB) in particular facing a most demanding and dynamic situation in the capital city.

https://www.london-fire.gov.uk/careers/become-a-firefighter/

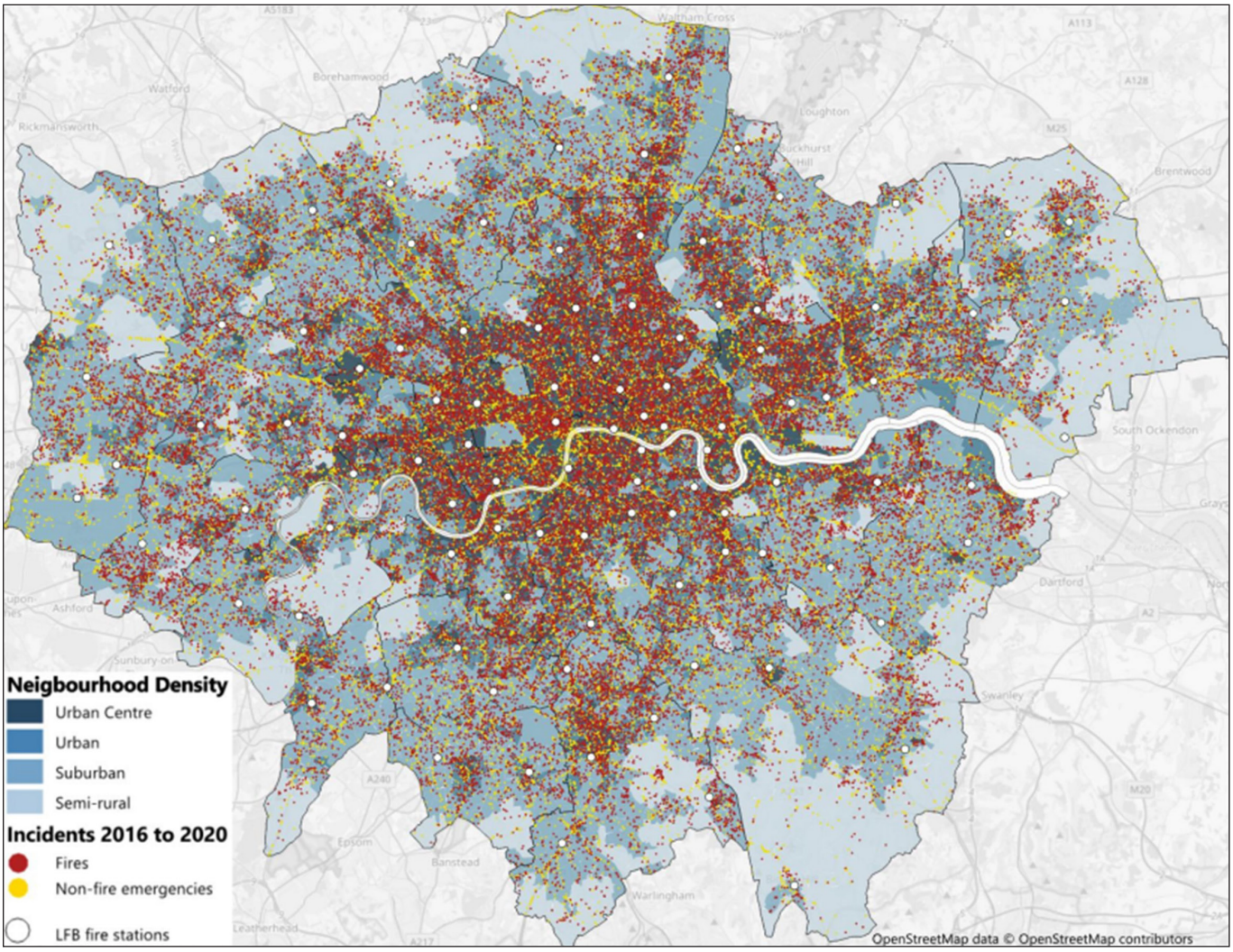

Figure BDM01-10.3.1 Neighbourhood Density and Incidents 2016–2020 – LFB

The combined map shows neighbourhood densities and incident occurrences in the LFB area over the period from 2016 to 2020. It also shows the distribution of LFB fire stations, and is reproduced from the *Assessment of Risk* (AoR), authorised by the London Fire Commissioner (LFC), and published on 29 April 2022.

https://london-fire.gov.uk/media/6688/crmp-aor-30-may.pdf

The *Fire and Rescue National Framework* for England, published on 8 May 2018, places a duty on all Fire and Rescue Services to "... identify and assess the full range of foreseeable fire and rescue related risks their areas face". The LFC's AoR is the LFB's response to that requirement.

It sets out all foreseeable risks which the LFB might be expected to respond to, and assesses their risk based on a combination of their likelihood and consequence. All other English Fire and Rescue Services also respond to the *Fire and Rescue National Framework* 2018.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/705060/National_Framework_-_final_for_web.pdf

The Scottish Fire and Rescue Service (SFRS) is expected to deliver on the *Fire and Rescue Framework* for Scotland, which was last published on 29 March 2022.

https://www.gov.scot/publications/fire-rescue-framework-scotland-2022/

The Welsh Fire and Rescue Services are expected to deliver on the *Fire and Rescue National Framework* 2016, which was published in November 2015 and updated with a Progress Report in January 2022.

https://gov.wales/sites/default/files/publications/2019-05/fire-and-rescue-national-framework-2016.pdf

https://gov.wales/sites/default/files/publications/2020-01/national-framework-for-fire-and-rescue-services.pdf

The Northern Ireland Fire and Rescue Service (NIFRS) is expected to satisfy the Fire and Rescue Services (Emergencies) Order (Northern Ireland) 2011.

https://www.legislation.gov.uk/nisr/2011/360/contents/made

Property protection

Fire and Rescue Services across the four devolved administrations are all expected to prioritise health and life safety. Consequently, they are all concerned primarily with self-evacuation where possible, and rescue where necessary, subject to the health and life safety of firefighters in a dynamic emergency situation. Intervention to extinguish a fire is devoted to health and life safety. Their professional duty is not to take avoidable risks to save property. This requires decisive judgement.

It may be possible to safely undertake a carefully planned salvage operation as Principle P, and measures in the Resilience Strategy may achieve damage limitation in reality, but property protection is a benefit rather than a mandate.

Health and life safety

In November 2022, *An in-depth review of fire-related fatalities and severe casualties in England, 2010/11 to 2018/19* was published by the Home Office. This study by Alexandra Bartlett, Isabel Preston, and Molly Watts, introduced by the Interim Director of Fire Sarah Gawley, was made possible by the support of local Fire and Rescue Services and the NFCC. The aims of the review were to:

- better understand of the circumstances of fires that result in fatalities and severe casualties;
- examine the risk across the population of being a severe casualty or fatality of fire;
- understand the differences between fatal fires and fires which result in a severe casualty;
- explore the behaviours of fatal victims of fires, leading up to and during the fire; and
- assess the consistency of fire investigation reports and recommend best practice for documenting fire-related fatalities in future.

https://www.gov.uk/government/publications/an-in-depth-review-of-fire-related-fatalities-and-severe-casualties-in-england-2010-to-201819/an-in-depth-review-of-fire-related-fatalities-and-severe-casualties-in-england-201011-to-201819

English trends

While there was discussion of data from 1982, the Home Office review concluded that between 2010 and 2019 in England:

"There has been a long-term downward trend in fires, fire-related fatalities and severe casualties over time. In the context of an increasing population, the overall risk of being involved in a fire involving a severe casualty or fatality has decreased. However,

in the context of the number of fires decreasing, the risk of a fire resulting in a fatality has increased."

Why increasing risk of fatality rather than "severe casualty" was observed was not further discussed. With injury a larger category than "severe casualty", and some consequences for health in later life unknown. Dwellings generally, and the poor housing of low income households, being noted:

"Fatal and severe casualty fires are highly prevalent in dwellings, are largely accidental, and there are evident risks associated with smoking material. The geographic location of fatalities and severe casualties do not differ extensively with both being highly correlated with deprivation."

Ethnicity was poorly reported, and could not be reviewed. There was no discussion in the review about evacuation policy, which influences the standard of detection and alarm, as Principle R. However, the review observed the widely recognised sleeping risk, discussed as Principle G:

"When a fire is discovered and the timeliness of notifying the FRS influences its outcome. Victims' activities at the time of fire, such as whether they were asleep, is therefore often a very important factor in the potential outcome of the fire, along with their actions upon discovering the fire, and any actions of witnesses."

CP3 Chapter IV

Evacuation Strategy is highly contested since the discrediting of the "Stay Put" policy in the Grenfell Tower fire on 14 June 2017. The origin of policy is *British Standard Code of Practice CP3 Chapter IV – Precautions against fire – Part 1. Fire precautions in flats and maisonnettes* (sic) over 80ft in height, 1962, submitted to the Grenfell Tower Inquiry as evidence LFB00060983. It is said on page 8 that:

"The assumption should no longer be made that buildings must be evacuated if a fire occurs and high residential buildings should, therefore, be designed so that the occupants of floors above a dwelling which is on fire may, if they choose, remain safely on their own floor. It may be necessary to evacuate the floor on which the fire occurs, and in some circumstances those floors which are in the immediate vicinity of the fire, but the occupants of these floors should be free to reach safety in any other part of the building via the staircase."

Universal escape

The principle of "... if they choose" is being re-examined, with attention given to detection and alarm systems as Principle R, along with the adequacy of protection of escape routes to an external place of safety for a sufficient period of time. The universality of the choice to remain or self-evacuate, rather than taking refuge and waiting to be rescued, has become a controversy central to the health and life safety objective. The argument also goes to the Disability Discrimination Act 1995, and has become a legal matter, while the provision of Refuges in protected escape routes assumes compartmentation will hold.

https://www.legislation.gov.uk/ukpga/1995/50/contents

Grenfell "Stay Put"

The "Stay Put" policy similarly assumes compartmentation will hold. In the case of Grenfell Tower, the compartmentation was defeated by the ferocity of the combustible external wall fire as a result of the refurbishment. A large number of Flat compartments were involved in the fire at the same time, which exposed other weaknesses in the escape route compartmentation. This meant that the belated cancellation of the "Stay Put" policy during the fire event by the overwhelmed Fire and Rescue Service of the LFB was too late. Some residents chose not to remain in their Flats, and survived by ignoring advice. This option was not available to those who were unable to self-evacuate, but for whom there was no place of safety inside the building either. Others became trapped.

https://www.grenfelltowerinquiry.org.uk/phase-1-report

"Stay Put" policy

The critique of the "Stay Put" policy in other Flats with similar risks in the combustible external wall resulted in the laborious and expensive provision of a "Waking Watch" with temporary adoption of simultaneous evacuation. The NFCC continue to update their *Guidance to support a temporary change to a simultaneous evacuation strategy in purpose-built blocks of flats*, which was last updated in August 2022 as the Fourth Edition.

https://www.nationalfirechiefs.org.uk/stay-put-position

https://www.nationalfirechiefs.org.uk/simultaneous-evacuation-guidance

https://www.nationalfirechiefs.org.uk/SEG-FAQs

Refuge dependency

The inequality in the creation of dependence upon rescue by the Fire and Rescue Service, by the provision of "Refuges", continues across the residential stock.

PEEPs guidance

The Home Office supplementary guide *Fire safety risk assessment: means of escape for disabled people*, published in March 2007, seems to have been abandoned by the Home Office themselves, based as it was on Personal Emergency Evacuation Plans (PEEPs). At this time the Home Office sensibly expected the Evacuation Strategy "... should not rely upon the intervention of the Fire and Rescue Service to make it work". It was also anticipated that there would be some building adaptation to facilitate escape, to reduce need for personal assistance.

https://www.gov.uk/government/publications/fire-safety-risk-assessment-means-of-escape-for-disabled-people/fire-safety-risk-assessment-means-of-escape-for-disabled-people-accessible-version

PEEPs consultation

The public consultation on PEEPs from June to July 2021 resulted in the Home Office *Personal Emergency Evacuation Plans in High-Rise Residential Buildings – recommendations from the Grenfell Tower Inquiry Phase 1 report: Government response*, published in May 2022. The majority of responses support the proposal to require the "Responsible Person" to prepare a PEEP for every resident who self-identifies to them as unable to self-evacuate. This includes residents with disabilities, health difficulties, or cognitive issues whose mobility is limited. That consultation response seems to have been unacceptable to government, and the question was put another way.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1081886/PEEPs_Consultation_Response.pdf

EEIS consultation

Government proposed Emergency Evacuation Information Sharing (EEIS) with further consultation to conclude by August 2022. EEIS appears to rely on the "Stay Put" policy predicated on compartmentation and fire extinguishment. This avoids answering the question, raised by the Home Office in 2007, of how all can escape when the fire is not extinguished before the compartmentation fails, and escape routes become unusable without intervention by the Fire and Rescue Service.

https://www.gov.uk/government/consultations/emergency-evacuation-information-sharing/eeis-consultation-document

Clarification required

It is currently difficult for any client to produce an Evacuation Strategy within a Fire Strategy, whether for an existing building or a new development, when even expert thinking about escape for universal health and life safety is in disarray.

This lack of a principled health and life safety approach to escape makes it all the more necessary for clients to consult with the Fire and Rescue Service as Principle C, with a view to establishing a Resilience Strategy as Principle A. The early conversation should consider property protection enhancements and also clarify the Evacuation Strategy.

"Stay Put" is supported as policy by the LFB: "Our guidance is to stay put unless your flat is being affected by fire or smoke."

https://www.london-fire.gov.uk/safety/the-home/escape-plan/escape-plan-blocks-of-flats/

What if the compartmentation fails to protect the escape routes?

What if you or people around you are unable to escape unaided?

London Plan 2021

Some practical efforts on escape are being made in the *London Plan 2021*.

https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/london-plan-2021

According to this plan, all new London developments are to be "... designed to incorporate safe and dignified emergency evacuation for all building users. In all developments where lifts are installed, as a minimum at least one lift per core (or more subject to capacity assessments) should be a suitably sized fire evacuation lift suitable to be used to evacuate people who require level access from the building". Applicable to new developments, but existing buildings are unaffected.

https://www.london.gov.uk/sites/default/files/evacuation_lifts_d5_b5_pre-consultation_draft_guidance_sheet.pdf

Evacuation lifts

Evacuation lifts are a practical measure in the inclusive design Policy D5(B5) of the *London Plan 2021*. But planning policy in London cannot resolve doubts over the "life safety before collapse" capabilities of the existing stock of "Stay Put" residential buildings. When offering pre-consultation guidance for information on new applications, the London Assembly talks about "resilience", but they may not mean property protection or wider issues for a Resilience Strategy as Principle A.

https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/fire-safety-guidance-pre-consultation-information

Number of stairs

Merely insisting that two protected stairs are better than one in particular Purpose Groups is not an Evacuation Strategy. That insistence fundamentally changes architectural form in new buildings and says that existing buildings with single stairs are unsafe. The controversy around stair provision in new and existing residential buildings concerns the NFCC, as discussed in BDM01-5.4. A market for retrofitting external escape stairs may be created.

Requirement B1

It is not sufficient to cite Requirement B1 Means of warning and escape in Schedule 1 of the Building Regulations 2010, as BDM01-11. Instead, it is necessary to establish what this important legal requirement means in practical terms for the intended occupants, within the Purpose Group for the project.

Purpose Groups

Sleeping risk is common to all residential development. However, important controversies about health and life safety as the focus of the Fire and Rescue Service reasonably rage beyond Purpose Group 1 for private Dwellings into Purpose Group 2 for institutional and other buildings with a wide range of sociological and behavioural concerns. This means that residential Evacuation Strategy remains in some practical confusion. For other Purpose Groups, confidence in escape provisions formalised in statutory guidance written for professionals has not been shaken by a recent fatal event like the Grenfell Tower fire in Purpose Group 1. This may be because fatal fires in the history of other Purpose Groups led to lessons being learned and strategies improved, sometimes through considered regulatory change.

Decision making

The underlying issue in Purpose Groups 1 and 2, if not in others, is one of who makes the decision about what constitutes a safe Evacuation Strategy within a safe Fire Strategy. This is returned to in Principal Z as a matter for reflection.

Trust

Residents are asked to trust the "Responsible Person" appointed by the building owner or operator, who may or may not have a facilities manager, or to trust the client, consultants and contractors who precede them. These several professionals need sensible answers to questions about escape, along with excellent communication skills.

Confidence

A Fire Strategy with the narrow legal objective of "life safety before collapse" will inspire little confidence as the basis for an Evacuation Strategy. A residential Evacuation Strategy that allows time for delays or postponements of escape, whether unaided or with assistance, should have the same basis as the Resilience Strategy as BDM01-4.

Time for escape

Residents need a prolonged time for escape, paid for by investment in the passive compartmentation of fire resisting floors and walls, perhaps augmented by an active suppression system of established worth, as Principle I. Sprinklers provide suppression, reducing fire severity within the compartment. However, when operating as intended, they offer no guarantee that the fire will be extinguished. A compartment that holds for longer than the time taken for the contents to burn themselves out will help firefighters to actively extinguish the fire, allowing time for escape and professional firefighting. The principle of burn-out has been neglected.

Fire development

Compartment fires have an overall pattern of ignition, growth, "flashover" to full development, decay, and complete extinguishment. Sprinklers provide suppression to delay growth, perhaps denying "flashover" to full development. Extinguishment at any phase of fire development requires the intervention of the Fire and Rescue Service. Burn-out is not to be imagined complete until extinguishment is confirmed by Fire and Rescue Service intervention, because smouldering combustion may persist to permit a revival of flaming combustion. Compartment burn-out and full structural protection are further discussed as BDM01-10.8 in relation to Principle H.

Limitations of a fire

Fire development is described in the growth phase by the National Institute of Standards and Technology (NIST) in the US Department of Commerce as the fire dynamics of a "ventilation limited fire" as contrasted to a "fuel limited fire":

"In this case the fire starts in a structure which has the doors and windows closed. Early in the fire growth stage there is adequate oxygen to mix with the heated gases, which results in flaming combustion. As the oxygen level within the structure is depleted, the fire decays, the heat release from the fire decreases and as a result the temperature decreases. When a vent is opened, such as when the fire department enters a door, oxygen is introduced. The oxygen mixes with the heated gases in the structure and the energy level begins to increase. This change in ventilation can result in a rapid increase in fire growth potentially leading to a flashover (fully developed compartment fire) condition."

https://www.nist.gov/el/fire-research-division-73300/firegov-fire-service/fire-dynamics

"Roll over"

There are two ventilation induced phenomena. The internal opening of a fire door, leading to a plume of fire projecting across the ceiling or soffit above the heads of firefighters, is a danger to the Fire and Rescue Service entering a compartment that is on fire. This internal ventilation phenomenon is called "roll-over".

"Autoexposure"

A different phenomenon occurs in the situation when the external window, door or vent is open, or when annealed glass in the external wall fenestration shatters in the heat, ventilating the compartment from outside. That ventilation from outside results in a plume of fire and hot gases projecting through the non-fire resisting external opening. The upward external spread of a fire plume from opening to opening, involving another compartment each time, is called "autoexposure" by Vincent Dunn in *Safety and Survival on the Fireground* – Second Edition 2015. This process is also described as "leap frogging".

The architectural fenestration of non-combustible and fire resisting construction across compartment lines, separating openings as Principle K, aims to slow the process of "autoexposure". The Fire and Rescue Service must control "roll over".

Ventilation

The NFCC illustrate "Modern Fire Development", but the diagram does not distinguish between internal "roll-over" and external "autoexposure" or "leap frogging". Instead, it aims to show that fire growth is not determined only by the compartment and its contents, and that ventilation, whether from inside or outside, affects compartment fire development.

Moreover, ventilation can be affected by adverse weather, as Principle M, because the external wall and internal fire doors may allow wind to blow through.

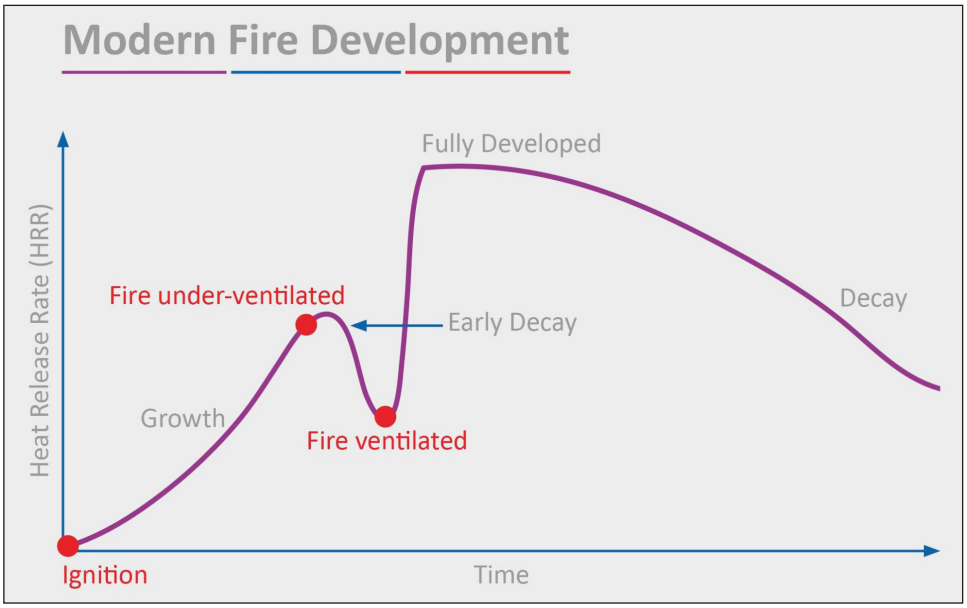

Figure BDM01-10.3.2 Modern Fire Development – NFCC

NFCC *National Operational Guidance – Hazard – Fire and thermal radiation*

https://www.ukfrs.com/guidance/search/fire-and-thermal-radiation

Fire phases

Incipient phase

After accidental or deliberate ignition, the incipient growth stage may initially be slow. However, for some construction or contents, their materials may burn quickly. Decisive intervention by occupants may extinguish the fire before it grows.

Growth phase

The growth phase incorporates rapid fire development, depending on an adequate availability of fuel, heat, and oxygen as the "fire triangle". This stage normally concludes in flashover unless restricted by a lack of fuel, heat or oxygen.

Fully developed phase

The fully developed phase represents a period of burning where the maximum heat is released, and all compartment surfaces and contents are involved. This is usually when the majority of the energy in the fire load is released.

Decay phase

The decay phase follows the fully developed fire. During this period, much of the energy in the fire load continues to be released but the fire declines in intensity as the burning rate decreases. The NFCC do not show when extinguishment occurs.

Smouldering fire

Reignition can occur in a smouldering fire deep in materials or when undetected in cavities, allowing the fire to grow again.

Control of fire

The Fire and Rescue Service will discuss how fire can be controlled. This is one of the more enlightening aspects of client consultation as Principle C, perhaps with the "Lead Designer" already appointed. It is a discussion about control in design and construction that can be returned to in Principles D to Y, providing lessons for all professionals involved at different times through the Work Stages.

The LFB has a fire engineering department and provide consultation.

https://www.london-fire.gov.uk/about-us/services-and-facilities/services-we-offer/fire-engineering-consultations/

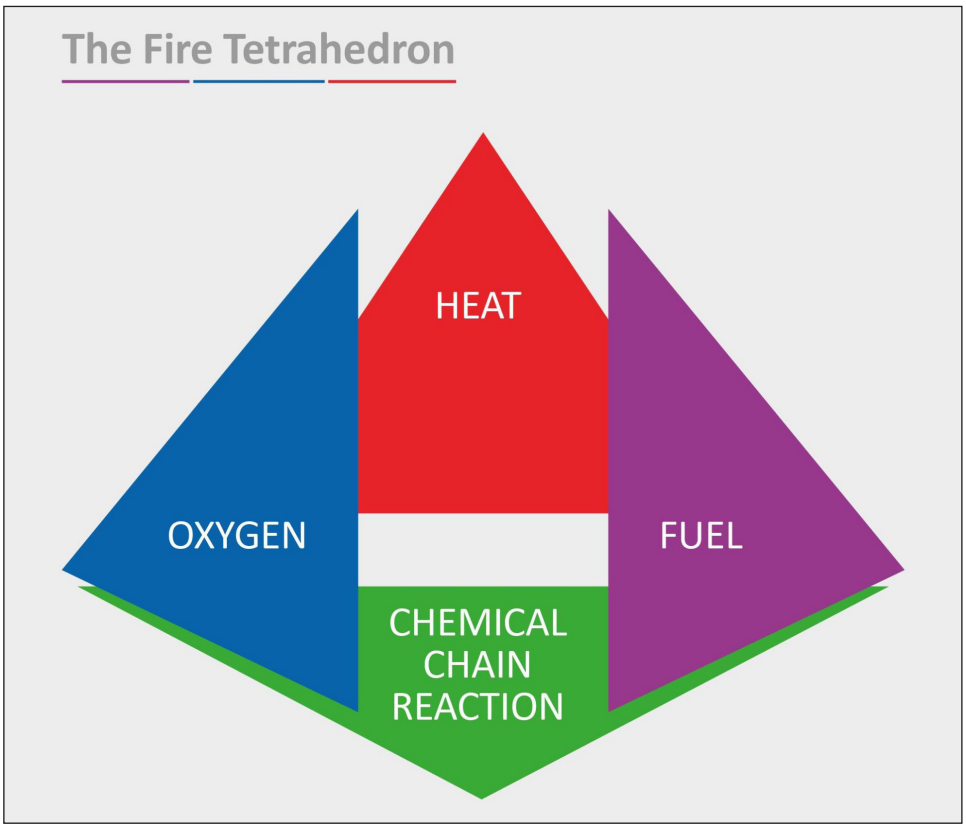

Figure BDM01-10.3.3 The Fire Tetrahedron – NFCC

NFCC *National Operational Guidance – Hazard – Fire and thermal radiation*

https://www.ukfrs.com/guidance/search/fire-and-thermal-radiation

Fire tetrahedron

Principle D is about removing fuel from the "fire triangle", which the NFCC also recognises as a "fire tetrahedron" when chemical reactions are considered. Water in firefighting is about removing heat, while use of foam instead is about removing oxygen. A lithium-ion battery fire involves a runaway chemical reaction that generates oxygen, produces heat, and consumes fuel.

RISCAuthority guidance on emerging issues with the commercial proliferation of lithium-ion batteries is identified for Principle F.12 in BDM01-10.6, generally for facilities management as Principle W in BDM01-10.23, and as Principle X.5 in BDM01-10.24. Sprinklers are addressed as Principle I in BDM01-10.9, and consequential considerations of suppression technologies are referred to as Principle N in BDM01-10.14. However, suppression systems are incapable of suppressing a runaway chemical reaction in a lithium-ion battery.

Hot smoke

Hot smoke leaking into an escape corridor may contain gaseous fuel that has been denied the oxygen needed for combustion. This can happen when doors, curtains or shutters are open, or when the compartmentation of floors and walls fails, particularly where penetrated by building services. That buoyant layer of hot smoke will travel across a ceiling or soffit. If the hot gas in a buoyant smoke layer obtains oxygen in a corridor, it may combust. Firefighters are trained against the risk of being trapped by "roll-over".

Cold smoke

As smoke cools, it loses the buoyancy of a hot gas and ceases to pose a "roll-over" threat. However, a colder smoke logged corridor is a serious problem for occupants escaping. Visibility is impaired, occupants are disoriented when trying to escape, and the toxicity of smoke is a threat to health and life safety.

Smoke as the killer

In a fire event, smoke kills rapidly and more often than direct exposure to heat and flame. The additional factor of smoke toxicity is involved, and addressed as Principle C.18. Despite best efforts in the Resilience Strategy made to maximise non-combustible construction as Principle D.1, combustible compartment contents produce toxic smoke during a fire event.

This is not to suggest that combustible construction can be chosen as Principle D.2 without knowledge about smoke toxicity as Principle S.8. It is more to recognise that contents and construction are different, and to better appreciate that sprinkler systems which suppress fire growth in the contents within compartments also help to reduce smoke quantity, with associated harmful qualities.

There is increasing appreciation of the qualitative question of smoke toxicity for health and life safety. Individuals who survive acute toxic smoke inhalation during escape can develop chronic health conditions later in life, as the Fire and Rescue Services know only too well.

Yet the toxicity of smoke is not addressed in Schedule 1 Requirements of the Buildings Regulations 2010, and consequently the statutory guidance as BDM01-16 (E-AD-D) does not consider smoke as a toxic substance:

(E-AD-D)

Approved Document D: Toxic substances

(1992 as amended 2002, 2010 and 2013)

https://www.gov.uk/government/publications/toxic-substances-approved-document-d

Compartmentation

Compartment construction shall prevent smoke entering compartments adjacent to the compartment of fire origin within the building, particularly when compartments are meant in a fire situation to be protected escape routes, horizontally as corridors and lobbies, or vertically as stairs, possibly with evacuation lifts.

Service risers

Service risers are compartments that are frequently accessed off protected escape routes but which penetrate compartment floors. The decision to introduce fire resistant construction vertically at the access doors or horizontally in fire stopping at every level profoundly affects Principle F for the building services. This decision also influences the resolution of Principle I.

Smoke shafts

Smoke ventilation shafts as part of a smoke control system are different to service risers because their smoke vents open or close off protected escape routes, while they penetrate compartment floors. Principle C.17 introduces a series of checking actions from early consultation that lead to a demonstration as Principle V.2.

Principle C.17

Smoke ventilation shafts, agreed with the Fire and Rescue Service as Principle C.15 and constructed as Principle D.12 using construction tested for viability as Principle S.7, are tested complete to achieve a Smoke Leakage (S) rate as Principle F.2, integrated with the detection and alarm system as Principle R.2, and demonstrated in operation with other smoke control systems as Principle V.2.

Universal (S) rating

Smoke Leakage (S) rate testing as Principle F.2 may be universally extended to compartmentation as Principle I.17. Some consultants and contractors may complain, but there were also objections to the introduction of air leakage testing of the external walls and roof of the whole building, and that is now routine business sanctioned by the Secretary of State, as discussed in BDM01-10.6.

SCA guidance

The client, perhaps prompted by the Fire and Rescue Service, may refer to *Guidance on Smoke Control to Common Escape Routes in Apartment Buildings (Flats and Maisonettes)*, published by the Smoke Control Association (SCA). The First Edition was published in November 2010 and Version 3.1 was published in July 2020. Importantly, this SCA guidance is only for Flats as Purpose Group 1a operating a "Stay Put" policy. It is unsuitable for buildings operating either phased or simultaneous evacuation in any other Purpose Group.

https://www.smokecontrol.org.uk/client/files/SCA_Guide_Common_Escape_Routes_in_Apartments_Revision_3_1_July_2020.pdf

The NFCC has noted the SCA recommendations for:

- limiting the length of common protected escape corridors to 30m measured from the furthest apartment door to the protected lobby door or unlobbied escape stair door;
- extraction of smoke and heat away from the lobby or escape stair;
- consideration of firefighting "tenability"; and
- simplification and consistency of firefighter system controls.

"Tenability"

For the Fire and Rescue Service "tenability" refers to the "life safety before collapse" objective of building legislation, with the Evacuation Strategy reliant on the smoke control system. For a broader meaning of firefighting operations the Resilience Strategy is needed as Principle A. There is a need to address cold smoke leakage at low level, lacking buoyancy, and unable to rise through convection.

Reality check

Computational Fluid Dynamics (CFD) modelling and analysis may be requested by the Fire and Rescue Service. Studies shall not ignore adverse external weather conditions, in which patterns of open windows and doors, or shattered glazing, combined with wind effects will challenge the smoke control system. This should be discussed with the Fire and Rescue Service in anticipation of Principle M.

In June 2021 *SCA Guidance on CFD analysis for Smoke Control design in Buildings* Edition 1.2 was published, and should be referred to.

https://www.smokecontrol.org.uk/client/files/SCA_Guidance-June_21.pdf

This may be read with the SCA guidance on *CFD Modelling for Car Park Ventilation Systems – a guide for designers and regulators*, published in February 2007.

https://www.smokecontrol.org.uk/client/files/13%20SCA%20CFD%20Guide.pdf

Containment

The legal purpose of smoke and heat ventilation is to protect the escape corridors, lobbies, and stairs for health and life safety. The SCA guidance also advocates preventing smoke and heat property damage to other compartments.

Selection

Principle D.1 advocates non-combustible materials, and architectural finishes that generate little or no smoke. Principle D.2 recognises that may not always be possible or desirable and allows for the selection of combustible materials.

10.4 Principle D – Maximise Non-Combustibility

Principle D – Maximise Non-Combustibility

Use non-combustible construction materials and products in systems, elements, and spaces, so far as reasonably practicable, as methods of construction that make minimal contribution to fire development and the generation of smoke.

D.1 Materials in construction are non-combustible subject to Principle D.2

D.2 Investors choosing combustible construction with reference to Regulation 7

D.3 Discounting fire-resisting internal non-structural joinery products

D.4 Cavities as Principles I, J and K constructed from non-combustible materials

D.5 Insulated Infill Panels are non-combustible in windows, doors, and vents

D.6 Extensive glazed walls with Insulated Infill Panels are non-combustible

D.7 System testing to both Parts of BS 8414 shall not contradict Principle D.1

D.8 No reliance made on "desk top studies" as Building Control Alliance TGN 18

D.9 External walls in protected zones are non-combustible and fire resisting

D.10 Openings for products as Principle D.5 are not within the protected zone

D.11 Escape stairs, lobbies, and corridors are non-combustible construction

D.12 Smoke ventilation shafts as Principle C.17 are internally non-combustible

D.13 Arson attempts are anticipated as Principle E in the design phase

D.14 Avoid a trade-off between Principles D, N and O in the design phase

"Relevant Buildings"

Regulation 7 of the Building Regulations 2010, as amended, is shown collated as BDM01-12. This legislation shall be complied with and limits the freedom of investors acting either as or through clients to choose combustible materials. This is a legal qualification on Principle D.2 for "Relevant Buildings" as Regulation 7(4).

Statutory guidance

The statutory guidance discussed as BDM01-5 gives practical meaning to Schedule 1 Requirements of the Building Regulations 2010, as BDM01-11. The statutory guidance is also subject to Regulation 7, as amended, discussed as BDM01-12. These provide a legal qualification on Principle D.2, while the statutory guidance is not legally binding on investors acting either as or through the client.

Principle D.2

Principle D.2 does not recommend the statutory guidance to Schedule 1 predicated on health and life safety can be ignored. Investors may select the alternatives provided in the non-mandatory but nevertheless statutory guidance where they are enhancements for resilience, but should consider carefully whether those choices weaken the design, compromising the already limited "life safety before collapse" objective of the statutory guidance for "common building situations".

Principle D.1 is preferable, but it is not always possible or desirable to use non-combustible materials, and therefore Principle D.2 may be applied.

Insulated Infill

Principles D.5 and D.6 advocate non-combustible Insulated Infill Panels (IIPs). In addition, Principle D.9 refers to Principles K and L for the deployment of fire resistance in the external wall, which shall include any frames into which IIPs are glazed, and the IIPs themselves. Frames may be combustible but the IIPs may not, subject to both being fire resisting as Principles K and L.

Fire resistance measured in time is limited to mechanical failure of combustible frames to retain the IIPs glazed into them as Principle D.10.

External wall

Principles D.9 and D.10 apply to all component products comprising external wall systems, to enhance compartmentation as Principle I, as a qualification on Principle D.2 when investors choose to depart from Principle D.1.

Primary structure

To insist on non-combustible primary structure throughout a building would mean a prohibition on the use of timber. RIBA experts appointed by Jane Duncan did not advocate universal non-combustible construction in 2018:

"The RIBA Expert Advisory Group agreed that primary structural elements should not be included in a ban as the MHCLG consultation clearly related to Building Regulations requirement B4 – external fire spread, rather than requirement B3 – internal fire spread (structure)."

https://www.architecture.com/knowledge-and-resources/knowledge-landing-page/combustible-materials-ribas-position-explained

Timber panels

The Ministry of Housing, Communities and Local Government (MHCLG) under the then Secretary of State James Brokenshire did not agree. The MHCLG was later given the DLUHC departmental title. Discussed as BDM01-12, the legislation amending Regulation 7, though a partial prohibition for "Relevant Buildings", prevents timber primary structure that is within the external wall. This restricts the use of loadbearing timber panels as the backing wall in the external wall.

Concrete panels

Loadbearing timber backing walls are comparable in structural principle to the loadbearing reinforced Concrete Panel Systems (CPS) commercialised with government subsidy for residential "Tower Blocks" in the 1950s and 1960s.

Ronan Point 1968

These were swiftly abandoned by the UK in the recession of the early 1970s, mired in the John Poulson corruption scandal involving several politicians, and technically discredited following the gas explosion and fatal "disproportionate collapse" of Ronan Point, Newham, London in 1968. However, CPS continued to technically advance in other nations, while the UK began sometimes demolishing but often "over-cladding" uncomfortable existing CPS stock in the 1980s.

Architectural precast

The UK development of non-loadbearing but nonetheless heavy architectural precast concrete panels supported on a primary structural frame, whether solid or of a sandwich construction containing thermal insulation, is addressed in BS 8297:2017 *Design, manufacture and installation of architectural precast concrete cladding. Code of practice*. This is not loadbearing CPS because it is cladding.

Structural frames

Regulation 7, as amended, is not a "ban" on timber primary structure. There is no restriction on loadbearing timber in primary structural frames of columns, beams, and floors with non-loadbearing external walls. In 2022 this timber frame is promoted as the "New Model Building", initially by Waugh Thistleton Architects. Such timber frames are in contrast to steel primary structural frames, developed in the rebuilding after the Great Chicago conflagration of 1871, and to reinforced concrete primary structural frames, first patented for insitu casting by French engineer and builder Francois Hennebique in 1892. Precast reinforced concrete is a twentieth century development. These "trabeated" primary structural advances were all the new models of their day, making high-rise and light-weight cladding systems possible, to be later challenged only in the residential market by CPS.

Regulation 7 lobby

There is lobbying of DLUHC representing government to remove primary structure from Regulation 7, as amended, to readmit loadbearing timber panels as backing walls for purposes (d) and (e) of Section 1 of the Building Regulations 2010.

Definition

Before further continuing to consider combustible timber primary structure it is necessary to define how combustibility can be tested and classified, having learned lessons from the Grenfell Tower Inquiry.

Grenfell Tower 1972

Grenfell Tower was a non-combustible and fire resisting insitu reinforced concrete frame built in 1972. The architect Nigel Whitbread decided against using CPS, following the shock of Ronan Point, preferring instead a robust site cast reinforced concrete structure with some architectural precast elements as permanent shuttering in the external wall, which separated window openings.

Grenfell Tower 2012

The refurbishment proposal began when the initial demolition plans were dropped in 2012, and contracted from 2014 to 2016. Nigel Whitbread was not instrumental in the refurbishment that involved a Rainscreen "over-cladding", with combustible insulation, a cavity, and outer combustible cladding layers fixed to the concrete frame, defeating his original non-combustible and fire resisting design. He died aged 81 in 2019, after the fatal fire of 14 June 2017.

https://www.ribaj.com/culture/nigel-whitbread-1938-2019-grenfell-tower-designer-constantin-gras

Combustibility

The conventional definition of non-combustible materials has changed since the publication of BDM01 *Fire protection of buildings – Essential principles* and the RISCAuthority, FPA and RIBA published *Approved Document B: Fire Safety (Volume 2 – Buildings other than dwellinghouses) – Incorporating Insurers' Requirements for Property Protection*, both in 2015. Compare the current statutory guidance in BDM01-16 (E-AD-B), which no longer use the phrase "limited combustibility", with the following definitions applied until Grenfell Tower fire:

- Table A6 of (E-AD-Bv2)(2006 as amended 2010 and 2013) previously defined non-combustible materials as Class A1 to BS EN 13501-1, with the option of National tests to BS 476-4 and BS 476-11.
- Table A7 of (E-AD-Bv2)(2006 as amended 2010 and 2013) previously defined materials of "limited combustibility" as Class A2-s3,d2 to BS EN 13501-1, with the option of National tests to BS 476-11.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/441669/BR_PDF_AD_B2_2013.pdf

Day 68 of Inquiry

10 November 2020 was Day 68 of Phase 2 of the Grenfell Tower Inquiry, when a technical explanation was presented by Expert Witness Barbara Lane of Arup, titled *An explanation of the relevant Reaction to Fire tests and Classification methods to restrict the combustibility of external walls of high buildings*. The video of the technical presentation in three Parts and the transcript are available online.

https://www.grenfelltowerinquiry.org.uk/hearings/expert-witness-presentation-dr-barbara-lane-10-november-2020

The Day 68 technical presentation explained the reliance on BS 476 Parts 4 or 11 for non-combustible materials and materials of "limited combustibility":

- BS 476-4:1970 Fire tests on building materials and structures. Non-combustibility test for materials

- BS 476-11:1982 Fire tests on building materials and structures. Method for assessing the heat emission from building materials

Transpositions

The Day 68 technical presentation also considered the transposition in Tables A6 and A7 of the measurements obtained in National BS 476 Parts 4 or 11 to European Class A1 and Class A2 using tests in BS EN 13501-1. The equipment for BS 476-11 is the same for the BS EN ISO 1182 Furnace Test as BDM01-13.1, being one of the four standard test methods in BS EN 13501-1 for construction products.

Barbara Lane appears to make no significant criticism of the transposition between the National and European measurements of non-combustibility in Table A6 and "limited combustibility" in Table A7 of (E-AD-Bv2)(2006 as amended 2010 and 2013).

RADAR 1 Report

In 2000, the Department of the Environment, Transport and the Regions (DETR) had commissioned "Research into the Approved Document And its Revisions" (RADAR), mentioned in BRAC minutes from 2001, which were published as Grenfell Tower Inquiry evidence CLG00001051 and CLG00007308. The first RADAR report concerned the transposition of BS 476 measures of fire resistance in various Parts with BS EN 13501-2: *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*. RADAR 1 has not technically concerned the Grenfell Tower Inquiry except in association with the second report.

RADAR 2 Report

The second RADAR report concerned combustibility, and was an attempt to achieve a National transposition with BS EN 13501-1 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests*. While European Class A1 and Class A2 were transposed to BS 476 Parts 4 or 11, the problem arose when attempting to transpose European Classes B, C, D and E of increasing combustibility. The three Parts of RADAR 2 were published for the first time in 2002 by Grenfell Tower Inquiry, available in evidence by searching for:

- CLG00000950 – RADAR 2 Part 1
- CLG00000951 – RADAR 2 Part 2
- CLG00000949 – RADAR 2 Part 3

https://www.grenfelltowerinquiry.org.uk/

Product Directive

Transposition mattered to the DETR because, although more than a decade after the Construction Products Directive (CPD), European Norms were expected to meet no barrier to trade in National standards. Approved Document B (2000), based in the BS 476 series, was to be reconciled with the BS EN 13501 series.

Garnock Court 1999

Classification transposition also mattered after the fatal fire at Garnock Court, Irvine, North Ayrshire, Scotland in 1999. That fire resulted in a Select Committee public hearing, convened with the title the *Potential Risk of Fire Spread in Buildings via External Cladding Systems*. The DETR was warned by the Select Committee in a footnote to the report of 5 January 2000 that:

DETR warning

"'Class O' is a classification designed to limit the fire propagation and the spread of flame over the surface of a material. This classification is defined for the purposes of the Building Regulations, and is used for critical situations where a particularly high standard of performance is required. It is measured through a combination of test results from BS476: Part 6: 1989 and BS476: Part 7: 1987. **It should be noted that both 'Class O' and 'limited combustibility' are different from the classification 'non-combustible', which is the highest level of material performance on exposure to fire, and is measured by reference to test**

BS476: Part 4: 1970 or Part 11: 1982. In no circumstances are external cladding systems required to be non-combustible."

https://publications.parliament.uk/pa/cm199900/cmselect/cmenvtra/109/10907.htm

National Class 0

The BS EN 13501-1 European Class A1 was transposed non-combustible, while Class A2 was transposed "limited combustibility". It was necessary to know how Classes B, C, D, E and F were to be transposed to the National Approved Document B, then a single Volume AD-B (2000). The Select Committee referred to "Class O" when Class 0 had been for many years the most limiting specification for surface spread of flame on the external wall. Class 0 was based in testing to BS 476 Parts 6 and 7, but Class 0 was not the same as "limited combustibility". The Class 0 conundrum has exercised the Grenfell Tower Inquiry.

RADAR 3 Report

A third RADAR report does not appear to have been completed in 2001, but the BRAC Minutes suggest this was to consider other aspects of the BS EN 13501 series concerned with classification of flooring, roofing, and aspects of building services. There are three standards in the BS EN 13501 series that address combustibility, which use different tests and classifications:

- BS EN 13501-1:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests*
- BS EN 13501-5:2016 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests*
- BS EN 13501-6:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests on power, control and communication cables*

Distinct classes

BS EN 13501-1 has three distinct approaches to classification for:

- construction products, excluding floorings and linear pipe thermal insulation products;
- floorings;
- linear pipe thermal insulation products.

Flooring layers

Floorings are classified through BS EN ISO 9239-1:2010 *Reaction to fire tests for floorings. Determination of the burning behaviour using a radiant heat source*, as $A1_{fl}$, $A2_{fl}$, B_{fl}, C_{fl}, D_{fl}, E_{fl}, and F_{fl}, shown in Table 2 of BS EN 13501-1. Floorings range from stone, ceramics, concrete, liquid poured, and timber, considered as construction with a longer service life, to laminated planks, resistant sheet, and carpet that are changed more frequently with decorations. All may be combined with screed or raised floor substrates, which may cover layers of loadbearing insulation used as "void filler". Not all void filler need be combustible insulation, and not all raised floors include timber or plastics.

Fire door threshold

The insurer and the Fire and Rescue Service may be concerned with "burn down", particularly in Modular construction with cavities exposed below as Principle J. However, they may focus their concern to "burn under" fire door thresholds, particularly when they sensibly include smoke seals. In critical door locations, it is simpler to consider the build-up of components as Principle D.1. The threshold of a fire door shall not extend the cavity of a raised floor breaching compartmentation as Principle I, and may be flush for ease of access as BDM01-16 (E-AD-M):

(E-AD-M)

Approved Document M: Access to and use of buildings

https://www.gov.uk/government/publications/access-to-and-use-of-buildings-approved-document-m

(E-AD-Mv1) Volume 1 – *Dwellings* (2015 as amended 2016)

(E-AD-Mv2) Volume 2 – *Buildings other than dwellings* (2015 as amended 2020)

Flush access

Issues of flush access are always difficult in the external wall, where floors meet balcony roofs. BS 8579:2020 *Guide to the design of balconies and terraces* is instructive, and relates to Principle M when adverse weather is expected. In all cases, the fire resistance of internal and external walls shall be maintained. The 2022 amendment of Regulation 7(3)(k) as BDM01-12 treats a balcony surface as a floor under BS EN 13501-1, rather than as a roof under BS EN 13501-5.

Insulated pipework

Table 3 of BS EN 13501-1 classifies thermal insulation for linear pipework is as $A1_L$, $A2_L$, B_L, C_L, D_L, E_L and F_L. Principle D.1 encourages favouring the use of $A1_L$ and $A2_L$ pipe insulation with building services as Principle F, but recognises that the decision may be made to admit combustible products as Principle D.2. This is also managed through compartmentation, particularly at service risers, and attention to fire stopping of penetrations, as Principle I.

This is a specific classification for linear pipework thermal insulation. Any thermal insulation product for ductwork or other item of building services is a construction product tested to classes as Table 1 of BS EN 13501-1, with selection as Principles D.1 or D.2. The insulation thickness will be a factor as Principle F, and similarly requires attention to fire stopping of penetrations, as Principle I.

Roofing layers

The obvious example of a low impact use of combustible materials in a fire event is the flat roof waterproof membrane which, if designed and built well, promises to be a weathering against water damage. Applied over a non-combustible flat roof deck, and covered with non-combustible materials for ballast or paving, the combustible waterproof membranes present little fire risk for the insurer in the built-up layers of construction.

Components in flat and pitched roofing systems may be considered as Principle D.1 or D.2 to BS EN 13501-1. The different BS EN 13501-5 classification of roofing is further addressed in Principles H.4 and I.5, that also require the deployment of fire resistance to BS EN 13501-2. In Principle L.2, BS EN 13501-5 has value in resisting fire ingress from a neighbouring building.

MCRMA

Metal pitched roof systems are similar to external wall systems, whether built-up on site or prefabricated as metal faced sandwich panels to be sealed on site at joints. Trade association guidance for the sector is provided by the Metal Cladding and Roofing Manufacturers Association (MCRMA).

https://mcrma.co.uk/

LPCB and LPS 1181

The previous edition of BDM01 2015, prior to the amendments to Regulation 7, had accepted approvals by the Loss Prevention Certification Board (LPCB) to requirements of Loss Prevention Standard (LPS) 1181 for external and internal construction. These referred to Section 2.2 of the *LPC Design guide for the fire protection of buildings*, now withdrawn, and were published in 2014 as:

- LPS 1181 Part 1: Issue 1.2 *Series of fire growth tests for LPCB approval and listing of construction product systems. Part one: Requirements and tests for built up cladding and sandwich panel systems for use as the external envelope of buildings*
  https://www.redbooklive.com/download/pdf/LPS1181part1.pdf

- LPS 1181 Part 2: Issue 2.1 *Series of fire growth tests for LPCB approval and listing of construction product systems. Part two: Requirements and tests for sandwich panels and built up systems for use as internal constructions in buildings*
  https://www.redbooklive.com/download/pdf/LPS1181part2.pdf

LPS 1181 guidance from the BRE does not appear updated.

https://www.bre.co.uk/news/LPS-1181—The-Facts-487.html

Electrical cabling

The combustibility of electrical cabling is considered as Principle F.

Non-combustibility

With flooring, roofing, and aspects of pipework and cabling in building services having distinct classifications, the materials used in all other products are considered non-combustible when Class A1 or Class A2-s1,d0 to BS EN 13501-1.

Gross calorific value

All Class A2 products require a gross calorific value threshold of less than 3 MJ/kg for substantial components in the standard. Within that gross calorific value, the allowance of a small quantity of smoke (s1) but no melting droplets (d0) is included for Class A2-s1,d0. This allows small amounts of organic chemicals in adhesives, treatments or decorative finishes, which are declared before testing.

Class limitations

In Annex B of BS EN 13501-1, Section B5 provides a caution on the Assessment and Verification of Constancy of Performance (AVCP) used in classification reporting. The test laboratory does not sample the product.

The AVCP "systems" are defined in *Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC Text with EEA relevance*.

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32011R0305

The classification thresholds for construction products other than floorings and linear pipe thermal insulation products (under 300mm diameter) are provided in Table 1 of BS EN 13501-1. This arrangement of four tests, the measurements they produce, and the threshold criteria that define classifications upon which specifications are made for applications, all require comprehension.

Acronym PCS

Table 1 BS EN 13501-1 includes the acronym "PCS" but does not explain its meaning. BS EN ISO 1716:2018 *Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)* shows that the English "gross heat of combustion" is the Pouvoir Calorifique Supérieur (PCS) in French. These are both the same measure as the gross calorific value, with units of MJ/Kg, and measured in the BS EN ISO 1716 test with samples conditioned for humidity.

Future explanation

FIGRA, SMOGRA, LFS and THR, among other measures, are variously defined in BS EN 13501-1 and the test standards relied upon to obtain classification. Some of the phraseology concerned with "homogeneous products and substantial components of non-homogeneous products" takes a little understanding. A better explanation of BS EN 13501-1 may be developed in a future title of the BDM series, allowing BDM01 to be reduced in content.

At present, readers may refer to the informative Annex A for "Small, intermediate and large-scale fire tests for external wall construction" in PAS 9980:2022 *Fire risk appraisal of external wall construction and cladding of existing blocks of flats – Code of practice*, although PAS 9980 is concerned with the external wall. Annex A shows how comprehension of BS EN 13501-1 is more widely needed.

https://www.bsigroup.com/en-GB/standards/pas-9980/

Test equipment

See BDM01-13 for descriptions of test equipment used in the four test standards referred to in Table 1 of BS EN 13501-1 for construction products excluding flooring and linear pipe thermal insulation products:

13.1	BS EN ISO 1182	*Furnace Test*
13.2	BS EN ISO 1716	*Bomb Calorimeter Test*
13.3	BS EN 13823	*Single Burning Item Test*
13.4	BS EN ISO 11925-2	*Single Flame Test*

FireSEAT criticism

"Fire and Building Safety in the Single European Market" was the theme of a 2008 symposium held at the Royal Society of Edinburgh by FireSEAT, or Fire Safety Engineering Applied To... The fire engineers were considering BS EN 13501-1.

https://www.fireseat.eng.ed.ac.uk/fire-and-building-safety-single-european-market

Validation

In "The Regulation of Technological Innovation: The Special Problem of Fire Safety Standards", Vincent Brannigan made the point that there is a difference between verification of a product test and validation in the application of that classified product. He referred to BS EN 13501-1 by way of example.

https://www.fireseat.eng.ed.ac.uk/sites/fireseat.eng.ed.ac.uk/files/images/02-Brannigan.pdf

External application

As an employee of the thermal insulation manufacturer Rockwool, Birgitte Messerschmidt considered in more detail "The capabilities and limitations of the Single Burning Item (SBI) test" in BS EN 13823, and took the view that:

"Considering that the reference scenario for the Euroclass system is fire in a room it is only right to question the use of this for externally applied products. The challenge is to define a new reference scenario and a large scale reference test for facades."

https://www.fireseat.eng.ed.ac.uk/sites/fireseat.eng.ed.ac.uk/files/images/07-Messerschmidt.pdf

Standard "black box"

Angus Law, Graham Spinardi, and Luke Bisby published a paper titled "The rise of the euroclass: Inside the black box of fire test standardisation", in the *Fire Safety Journal*, as a "pre-proof" copy on 6 December 2022. The account of the development of BS EN 13501-1 is important, while the interviewees retain their anonymity. As the authors explain, "... the identities of participants in the relevant standardisation committees are confidential and the minutes of these meetings are not available", so that an incomplete list of participants in the development of BS EN 13501-1 was obtained. Of those known, some declined to be interviewed, and some were no longer alive or in sufficient health.

https://www.sciencedirect.com/science/article/pii/S0379711222001898

Absent criticism

Regrettably, the National classifications in tests to the BS 476 series were not similarly considered by fire engineers, or compared to the different European classifications from tests in BS EN 13501-1. Unfortunately too, the National fire test methods were not abandoned with the advent of BS EN 13501-1. While the development of European classifications is important, the decision to transpose and sustain National classifications is proving to be more important.

False correlation

Between 2000 and 2002 the DETR had decided to transpose National Class 0 to European Class B, and not to Class A2 as "limited combustibility" in Table A7. This was a statistical

correlation. Yet the Ministry knew from RADAR 2 that some National Class 0 products were also achieving European Class C, D or E. The three Parts of RADAR 2 were only published by the Grenfell Tower Inquiry in 2022.

Table 2: Transpositions of UK Class 0 to Euroclasses

Classification Transposition Point		Product Density at Transposition Point	Product Identification R2/ref.
UK	EC		
0	A1	1	2/05
0	A2	9	2/03, 2/06, 3/01, 3/02 6/01, 6/02, 6/03, 6/04, 6/07
0	B	21	1/01, 1/06, 1/09 3/03, 3/04, 3/05, 3/06 4/06, 4/08, 4/09, 4/10, 4/14 5/01, 5/02. 5/03, 5/05, 5/06 6/05 7/01, 7/06, 7/07
0	C	1	4/05
0	D	2	4/12, 5/04
0	E	1	1/03

they are?

Figure BDM01-10.4.1 Table 2 from RADAR 2 CLG00000951 – GTI

BS 476 Parts

By the 1990s, manufacturers had innovated composite cladding and insulation products for external walls that, with thin metal facings to combustible cores, could achieve Class 0 by testing to BS 476-6 [Index (I) <12 and Sub-Index (i1) <6] and BS 476-7 [Class 1]. However, "limited combustibility" related to BS 476 Parts 4 or 11. The longstanding double definition of Class 0 as Paragraph 13 of Appendix A in BDM01-16 (E-AD-Bv2)(2006 as amended 2010 and 2013) was:

"The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

a. composed throughout of materials of limited combustibility; or

b. a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6.

Note: Class 0 is not a classification identified in any British Standard test."

The "or" between 13a. and 13b. meant Class 0 could be achieved through the criteria derived in BS 476 Parts 6 and 7, without being "limited combustibility".

Composite cores

The test method in BS 476 Parts 6 and 7 was unable to prevent manufacturers of composite products with combustible cores getting to market with a Class 0 third party certification. The test methods were unable to identify composite products with combustible cores, as testing for classification under BS EN 13501-1 was better able to. Though the ability of the European Single Burning Item test to measure surface spread of flame appears inferior to BS 476 Part 7, the Paragraph 13b. National tests for Class 0 could not measure the combustibility of composite cores. Surface spread of flame and combustibility are different phenomena. There exist both non-combustible cores with high surface spread of flame facings and combustible cores with low surface spread of flame facings.

Diagram 40 (E-AD-B)

The products including composites that obtained National Class 0 were then incorrectly transposed by RADAR 2 with Class B European, with Class 0/B as an option through Diagram 40 in (E-AD-B)(2002). The Diagram 40 transposition was sustained into (E-AD-Bv2)(2006 as amended 2010 and 2013), approving either National Class 0 or European Class B for the most onerous cases. This was unchanged to the Grenfell Tower fire on 14 June 2017.

Note 1 at the bottom of Diagram 40 pointed out that National and European classes did not "automatically equate". This gave the false impression that they could be approximately transposed as Class 0/B. Note 1 nowhere mentioned that National Class 0 could be European Class B or better, but could also be worse as European Class C, D or E, as those with access to RADAR 2 had been shown.

BS 476 Parts 6 and 7

Nowhere does Diagram 40 mention Class A2 or "limited combustibility". It is instructive to watch the Day 68 technical presentation by Barbara Lane and to read BS 476 Parts 6 and 7, to appreciate the test method and equipment:

- BS 476-6:1989+A1:2009 *Fire tests on building materials and structures. Method of test for fire propagation for products*
- BS 476-7:1997 *Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products*

Class 0 Conundrum

RISCAuthority has attempted to explain the "Class 0 Conundrum" in a publicly available webinar with accompanying Question and Answer document. This should be improved upon as the Grenfell Tower Inquiry publishes the Phase 2 Report findings and overall recommendations of Martin Moore-Bick.

https://event.on24.com/wcc/r/3704581/16E6B7D591896869A58200C81B6258AC

https://www.thefpa.co.uk/advice-and-guidance/public-webinar-archive?q=Class%200%20Conundrum

Unpublished RADAR

In chairman Martin Moore-Bick's Grenfell Tower Inquiry reports the Class 0 problem will be explained in relation to the decision not to publish RADAR 2. That no knowledgeable critique of combustible Class 0 was published before Grenfell Tower fire, including by those who had access to RADAR 2, also requires explanation. Particularly when there had been expert criticism of BS EN 13501-1 published in 2008.

Scale of testing

Many have promoted system testing as a panacea. As discussed in BDM01-6.6, Principle D has resisted the argument that product testing is inferior to system testing. It is flawed product classification in statutory guidance that has been criticised by the Grenfell Tower Inquiry, with evidence only published in 2022.

Critiques of BS 8414

The flaw in National Class 0, allowing combustible cladding to the market, is an important revelation that should be understood when reading two earlier documents, which stand as critiques of BS 8414 system testing:

- ABI, FPA and RISCAuthority, *Cladding Approvals: A review and investigation of potential shortcomings of the BS 8414 standard for the approval of cladding systems such as those commonly used on tall buildings*, 22 February 2018
  https://www.abi.org.uk/globalassets/files/publications/public/property/2018/04/abi-cladding-systems-research-report-2018-04-19.pdf
- Judith Schulz, Darren Kent, Tony Crimi, Jim L. D. Glockling and T. Richard Hull, "A Critical Appraisal of the UK's Regulatory Regime for Combustible Façades", *Fire Technology*, 57, 261–290 (2021)
  https://link.springer.com/article/10.1007/s10694-020-00993-z

Correction required

Correction is required in the paper by Judith Shultz et al. No Approved Document B, before or since the Grenfell Tower fire, has universally expected "… the use of non-combustible products on the outside walls of the building", in the absence of BS 8414 system testing

or a fire engineering approach. It is hoped the paper will be corrected because it is widely referenced and contradicts Barbara Lane.

BS 8414 Plus

RISCAuthority continues important research into improvements in BS 8414 system testing for property protection, to inform procedures at the FPA BS 8414 test facility, and to be incorporated into a future revision of BDM01.

Table B1 in AD-B

Both Volumes of BDM01-16 (E-AD-B) continue to approve the National BS 476 Part 6 and 7 test criteria without naming Class 0 in Table B1 *Reaction to fire classifications: transposition to national class*. This is contradicted by RADAR 2.

Cladding Toolkit

RISCAuthority have published an interactive *Cladding Toolkit* with a printable flow chart for the statutory guidance on external wall combustibility for each of the four devolved administrations. The toolkit and flow charts should be checked for their revision date as amendments to Building Regulations and statutory guidance are published in England, Scotland, Wales, and Northern Ireland.

https://www.thefpa.co.uk/advice-and-guidance/public-toolkits/cladding-compliance-toolkit

BS 476 withdrawal

National divergence from the European Norms is exercising the British Standards Institution (BSI), but the National BS 476 series was divergent from the European BS EN 13501 series. The withdrawal of the BS 476 series is overdue, and the BS EN 13501 series should be used. Recognising criticisms of the classification standard and the tests it relies upon, BS EN 13501-1 should be used unless a better National classification for combustibility of construction products can be developed. A better divergent approach may even be developed specifically for the external wall, in contrast to internal construction.

Surface spread

Renewed focus on combustibility should not detract from the problem of the speed of surface spread of flame that BS 476 Part 7 was developed to address. This may become particularly apparent as structural timber is further researched.

Structural timber

Principle D explicitly favours non-combustible construction, but there is commercial negotiation in Principle B. Combustible construction can be preferred by investors acting either as or through the client, and by their insurers, for environmental reasons. It is important to recognise the trend in investment decisions that favour timber as a material for primary structure, which fundamentally influences the Resilience Strategy as Principle A. Structural timber is combustible, and supports rapid surface spread of flame, but also needs to be thought about in terms of fire resistance as Principles H and I.

Timber industry

In 2022, Timber Development UK (TDUK) was formed by the merger of the Timber Trade Federation (TTF) and the Timber Research and Development Association (TRADA), to connect the supply chain and provide a comprehensive online library of technical specification and design guidance. With its origins in TRADA, BM TRADA has been a separate business for a period of time, and is currently part of Element Materials Technology. BM TRADA is not part of TDUK.

https://timberdevelopment.uk/

https://ttf.co.uk/

https://www.bmtrada.com/about-bm-trada

The Structural Timber Association (STA) is steadily publishing research on the fire performance of Mass Timber, Timber Frame, and Structurally Insulated Panels, with an emphasis on the functional requirements of Building Regulations for health and life safety. A Resilience Strategy would aim to manage structural loss.

https://www.structuraltimber.co.uk/timber-systems/research/mass-timber-fire-research/

https://www.structuraltimber.co.uk/timber-systems/research/timber-frame-fire-safety-in-use-guidance/

Wood for Good advocates fire retardant, fungicide and pesticide treatments along with marketing publications in their engagement with architects.

https://woodforgood.com/training-and-development/publications/

Loss reduction

Insurers are against foreseeable loss, not against timber as a material. The Great Fire of London in 1666 established the insurance market focused on Lloyd's Coffee House. From the seventeenth century and the invention of the masonry "party wall", insurers were devoted to the financial management of the risk of timber construction in urban development, alongside the avoidance of shipping losses. Use of non-combustible materials was deployed in cities to prevent conflagrations and total losses of the past. This informed the Ministry of Works (MoW) in the *Post-War Building Studies No. 20 Fire Grading of Buildings – Part I General Principles and Structural Precautions*, 1946, discussed as BDM01-10.8.

Industrial success

The availability of graded industrially sawn solid softwood and hardwood from around the world was a nineteenth century construction industry success. The advances in adhesives and processing for block, veneer, wafer, chip, or fibre based timber board products are part of twentieth century construction history, with the development of "Glulam" as an early structural use of adhesive.

Twenty-first century

The significance of combustible materials present in a range of structural methods varies considerably in the twenty-first century resurgence of timber technique:

- Solid timber joists for floors and flat roofs
- Solid timber rafters, purlins and trusses for pitched roofs
- Gang nailed open joists and perforated plywood web joists
- Gang nailed trussed rafter roof systems
- Light Timber Frame (LTF) panel systems
- Structurally Insulated Panel (SIP) systems
- Glulam massive timber frame systems
- Cross Laminated Timber (CLT) systems
- Laminated Veneer Lumber (LVL) systems.

There are also cold rolled Light Steel Frame (LSF) systems that incorporate timber boards within their layers of construction. Layers of materials should be identified in products and systems that comprise MMC. These may all manifest as Permanent Stacked Modular Buildings, discussed in Principle A.

Massive timber

There is an increasing preference among investors acting either as or through the client for heavy structural timber in more "massive" configurations as categories of MMC. This is in addition to the market for Light Timber Frame (LTF) primary structures.

For Massive Timber in high rise construction, RISCAuthority published a Questionnaire to assist insurers in eliciting information and considering fire and water damage risks, titled IQ6 *Building system questionnaire: Massive Timber System use in high-rise applications.*

https://www.thefpa.co.uk/resource-download/368

Insurance challenge

In January 2022 RISCAuthority subsequently published Revision 1 of a White Paper on the *Insurance challenges of massive timber construction and a possible way forward*, written by the then Technical Director Jim Glockling. This followed a series of discussions with members of the RISCAuthority Massive Timber Working Group to assess their view of the challenges, current situation, comfort thresholds, and possible routes forward. The paper proposed the "hybridisation" of primary structure using non-combustible concrete and steel with combustible massive timber. The White Paper was also presented in a publicly available webinar.

https://www.thefpa.co.uk/resource-download/401

https://event.on24.com/wcc/r/3692743/07BB81746EEBF6A1F06F0A4404269978

FSF Working Group

Further collaborative work is being undertaken through a Mass Timber Buildings Working Group chaired by Jim Glockling, organised by the Fire Sector Federation (FSF), following publication of the White Paper *Developing a National Strategy for Fire Safety* in October 2022.

https://www.firesectorfederation.co.uk/wp-content/uploads/2022/10/FSF-Developing-a-National-Fire-Strategy-for-Fire-Safety.pdf

"Self-extinguishing"

IQ6 Section 5.9 questioned the moment of extinguishment. It became apparent after 2017 that many academics think the char formed on massive timber primary structures exposed as wall and/or soffit if not floor construction in the event of fire can be used predictably in fire engineering. The academic thesis that massive timber may achieve "auto-extinction", "self-extinguishment" or "self-extinction" as a result of surface charring in fire had been investigated, with publication of a growing literature, particularly in the *Fire Safety Journal*:

- Alastair Bartlett, Rory Hadden, Juan Hidalgo, Simón Santamaria, Felix Wiesner, Luke Bisby, Susan Deeny, and Barbara Lane, "Auto-extinction of engineered timber: Application to compartment fires with exposed timber surfaces", *Fire Safety Journal*, Volume 91, July 2017, pages 407–413
  https://doi.org/10.1016/j.firesaf.2017.03.050
- Roy Crielaard, Jan-Willem van de Kuilen, Karel Terwel, Geert Ravenshorst, and Pascal Steenbakkers, "Self-extinguishment of cross-laminated timber", *Fire Safety Journal*, Volume 105, April 2019, pages 244–260
  https://doi.org/10.1016/j.firesaf.2019.01.008
- Hangyu Xu, Ian Pope, Vinny Gupta, Jaime Cadena, Jeronimo Carrascal, David Lange, Martyn McLaggan, Julian Mendez, Andrés Osorio, Angela Solarte, Diana Soriguer, Jose Torero, Felix Wiesner, Abdulrahman Zaben, and Juan Hidalgo, "Large-scale compartment fires to develop a self-extinction design framework for mass timber—Part 1: Literature review and methodology", *Fire Safety Journal*, Volume 128, March 2022
  https://doi.org/10.1016/j.firesaf.2022.103523

The idea was that during development of a compartment fire, combustion and charring of an outer thickness of redundant and sacrificial timber may protect the unburnt structural timber beneath. It was accepted that the char must not fall off to add more timber fuel to the fire. With the intention that, over time, the fully developed fire in the compartment may decay, and massive timber components may not have been consumed. Whether to afford time for the Evacuation Strategy only, as the "life safety before collapse" objective, or for a Resilience Strategy.

Design philosophy

The structural timber sector seized on the philosophy of "extinguishment by design" in massive timber, finding a receptive audience among investors, clients, consultants, and contractors. Massive timber is sold and bought as a "self-extinguishing", combustible, fire resisting product with environmental benefits.

This was beyond any test of fire resistance for structural Stability (R) or for compartmentation as Stability (R), Integrity (E), and Insulation (I), as classified in BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*, as Principle I. Imaginatively, the talk of "extinguishment by design" has subordinated thinking about combustibility of the adhered layers, and ignored thinking about the speed of surface spread of flame.

Jim Glockling referred to the dependency upon the "extinguishment by design" philosophy in the RISCAuthority *Insurance challenges of massive timber construction and a possible way forward*, Revision 1 – January 2022.

Proponents of massive timber "extinguishment by design" need to achieve the "life safety before collapse" objective of building legislation and satisfy Requirement B1 in Schedule 1 of the Building Regulations 2010, as BDM01-11. However, this legal minimum means the prospect of collapse. The law provides no Resilience Strategy, as Principle A. No legislation mandates that a compartment fire must burn-out before the compartment is breached, as Principle I, and before structural failure, as Principle H. All non-mandatory statutory guidance follows the law.

Compartment burn-out and full structural protection are further discussed as BDM01-10.8 in relation to Principle H, referring to the Ministry of Works (MoW) *Post-War Building Studies No. 20 Fire Grading of Buildings – Part I General Principles and Structural Precautions*, 1946.

F&RS intervention

RISCAuthority uphold the view that only the Fire and Rescue Service can confirm achievement of fire extinguishment by their active and persistent intervention in firefighting. "Who puts the fire out?" is an important question.

Reignition events

Timber construction does not extinguish itself. Beneath char, reignition can occur in a smouldering fire deep in timber materials or when undetected in concealed cavities, allowing the fire to grow again. If an unextinguished smouldering fire grows again the following day, resulting in collapse of the vacant building, the loss may be total. Worse still, parts of the building may have been reoccupied when the fire reignites, threatening health and life safety.

Inaccessible cavities

The NHBC Foundation publish an extensive series of guidance. In particular, NF51 *Fires in cavities in residential buildings – The performance of cavity barriers in external walls with combustible materials* – April 2013 is worth reading by anyone who thinks that timber structures will "self-extinguish" or are easy for the Fire and Rescue Service to extinguish.

https://www.nhbcfoundation.org/wp-content/uploads/2016/05/NF51-Fires-in-cavities-in-residential-buildings.pdf

Timber Frame 2000

TF2000 was a collaborative project in the 1990s between the government, BRE, TRADA Technology Ltd, and the timber industry, focused on the potential for medium-rise loadbearing Light Timber Frame (LTF) buildings in the UK. It was undertaken at the BRE's large building test facility at Cardington, Bedfordshire, on a six storey residential test structure.

https://projects.bre.co.uk/tf2000/index.html

Although TF2000 was archived and remains unpublished, it has been referred to in many MMC publications as a success. In 2013, however, NF51 *Fires in cavities in residential buildings*

reported on an incident in TF2000 that clearly concerned the NHBC Foundation. After a fire experiment had been completed, and the fire was thought to be extinguished, "... smouldering combustion led to fire spread into the cavity between the timber frame and the external masonry façade". This led to a reignition of flaming combustion and another fire. The potential for cavity fires, not only in the external wall but also in the internal compartmentation, is addressed as Principle J.

Reliance on charring

There are important differences between Light Timber Frame (LTF), which has air spaces around timber frame "studs" that can provide oxygen to a flaming or smouldering fire, and massive timber methods, with laminations of timber that form a surface depth char. The massive timber theory of "self-extinction", which is sometimes called "auto-extinction", relies on the assertion that flaming combustion is no longer possible because char depth both denies oxygen and insulates the timber fuel from heat, denying the "fire triangle".

For sufficient depth of char to form the structurally redundant timber fuel available over the entire surface of the massive timber has to combust. There has to be a fire in the timber material, with the highly redundant structure combusting and adding fuel load to result in charring. This is in addition to the fuel load of the combustible construction of the interior design and the contents of the compartment, broadly subject to Purpose Group. It should also be noted that timber fires produce a lot of smoke.

Structure on fire

Instead of a fire in a non-combustible building, the combustible building is on fire.

After the occupants have hopefully vacated a stable but combustible building, without being affected by flame, heat or smoke, the structure remains on fire.

Even in cases when undisturbed and sufficient charring serves to protect the structural timber from becoming a further mass of fuel in compartment fire development, the decay phase is not the end of the fire incident. The charred surface has the potential to continue as a smouldering fire that later reignites into flaming fire redevelopment when "fire triangle" conditions re-establish. This may be unseen below the char or in cavities, until fire regrowth breaks out.

F&RS stand back

Repetition of fire development may require the Fire and Rescue Service to chase the revived fire event through the building into other compartments, after redundancy in the timber structure in the initial compartment has already been lost. At some point when all occupants are evacuated, the Fire and Rescue Service may stand back for their own health and life safety, expecting collapse.

Total loss

Statutory guidance is silent on the expected prospect of the Fire and Rescue Service standing back to oversee a protracted, unextinguishable fire event through to collapse. Collapse and total loss after health and life safety may be acceptable to the investor, their insurer, building occupants, and the Fire and Rescue Service. Alternatively, that may be the definition of a lack of resilience.

R&D disclosure

It must be hoped that Research and Development (R&D) into MMC fire performance is fully disclosed in the 2020s, and that the habit of non-disclosure from the 1990s is discredited following the Grenfell Tower Inquiry.

Purpose Group 1(a)

Combining "Stay Put" with "extinguishment by design" in massive timber Purpose Group 1(a) residential Flats is not a resilient strategy and risks the health and life safety of residents and the Fire and Rescue Service, unable to rely on the uncertainties of the charring process. Fire engineers may come to understand massive timber structures as MMC, but they are still pushing a frontier of knowledge that is behind the proliferation of planning approved projects.

In his endorsement to the *Insurance challenges of massive timber construction and a possible way forward*, Revision 1 – January 2022, David Williams, the then Chairman of RISCAuthority, said:

"It should not be a surprise that insurance models and insurance customer expectations developed around historic solid walled, non-combustible construction types, may need to alter quite radically to address these very substantial changes in construction methods and material use."

Power to regulate

The power to make Building Regulations is currently exercised by the Secretary of State of DLUHC, as established in Section 1 of the Building Act 1984.

https://www.legislation.gov.uk/ukpga/1984/55/section/1

After health and life safety in Section 1(1)(a) of the Building Act 1984, the power to make Building Regulations is extended for the purposes of:

(b) furthering the conservation of fuel and power

(d) furthering the protection or enhancement of the environment

(e) facilitating sustainable development.

Market share

These purposes are given practical meaning throughout the statutory guidance as discussed as BDM01-5. For structure, the timber sector competes with the concrete and steel sectors to claim advantage for purposes (d) and (e). Since the 1990s and TF2000 in particular, the brick industry has come to a commercial compromise with the loadbearing timber sector over the market share for non-loadbearing external leaf in housebuilding. Brick consolidated into the architectural market, even as brick slips for external walls on high-rise loadbearing structures of concrete, steel and, increasingly, massive timber.

Masonry appearance

Since the Grenfell Tower fire, the choice of non-loadbearing brick has gained market preference in planning committees and among customers. This may be as an outer leaf, commonly half-brick thick with stainless steel support and restraint systems back to structural slab edges. This may be as brick slip systems on precast concrete panels, steel or aluminium supports in place of rainscreen panels, or adhered instead of render on External Thermal Insulation Composite Systems (ETICS). There are always architectural trimmings, and at times natural stone cladding or other fired clay rainscreen systems win approval. What appears to be a solid building tends to be a non-combustible outer face.

Backing walls

Backing walls for the cornucopia of architectural forms and finishes may be of concrete, steel, or timber in a wide range of loadbearing and non-loadbearing configurations, all providing weathering techniques. However, combustible backing wall technologies face a partial regulatory block since 2018.

Amending regulation

The Building (Amendment) Regulations 2018 extended Regulation 7 of the Building Regulations 2010. This was promoted as a "ban" on combustible materials in the external wall after the Grenfell Tower fire. However, this proscription was not universal, even for the legal purpose of health and life safety.

https://www.legislation.gov.uk/uksi/2018/1230/contents/made

The MHCLG, becoming the DLUHC, published *Building (Amendment) Regulations 2018: frequently asked questions* on 21 January 2020. These Frequently Asked Questions (FAQs) precede the FAQs discussed as BDM01-5.4.

https://www.gov.uk/government/publications/building-amendment-regulations-2018-frequently-asked-questions/building-amendment-regulations-2018-frequently-asked-questions

CWCT and SFE

The Centre for Window and Cladding Technology (CWCT) and the Society of Façade Engineering (SFE) published *CWCT/SFE Fire Guidance* in September 2020, as a close examination of the Building (Amendment) Regulations 2018 and the MHCLG FAQ. *CWCT/SFE Fire Guidance* may be revised over time and it predates the 2022 amendments discussed as BDM01-12. The CWCT and SFE accept no duty of care, obligation or liability, whatsoever, to their members or others, in relation to the use of *CWCT/SFE Fire Guidance* for any purpose.

www.cwct.co.uk/pages/cwct-sfe-fire-guidance

Regulation 7 change

The changes to Regulation 7 are discussed further as Principle T regarding 7(1)(a) and Principle U regarding 7(1)(b), and as BDM01-12.

The MHCLG FAQs relate to Regulations 7(2) and 7(3), which do not address the combustibility of the roof or any internal construction of "Relevant Buildings", by definition. The internal and external construction of non-7(4) buildings, not being a "Relevant Building", may be combustible.

Regulation 7(3) does not exclude the following, and so Regulation 7(2) applies to:

- mechanical building services; and
- drainage systems.

Services externally

The external wall may include mechanical ventilation terminals and rainwater drainage from balconies or terraces. Roofs will have similar penetrations for building services, which include drainage. In the internal construction, the use of plastic ducts and pipework can be extensive, whether concealed in non-fire resisting cavities below raised floors, behind linings, or above suspended ceilings, or arranged in service risers that are fire resisting compartments. Building services integration is further discussed as Principle F.

The contribution of building services to the measure of combustible materials can be significant. Some judgement can be made about combustible building services subject to fire resisting compartmentation for service risers as Principle I.

Joinery products

Principle D.3 allows for non-structural joinery products such as fire doorsets. Yet timber supports are often used, concealed within internal wall and soffit or ceiling systems. These may be described as non-loadbearing by a structural engineer while the insurer may take another view. The meaning of non-structural joinery products should not be stretched to include extensive timber cladding externally, or timber panelling or linings internally. Discretion is required.

Curtain wall FAQ 9

External windows, doors, and vents as Principle D.5 are consistent with Regulation 7(3) which permits timber to be used externally for window frames and glass, door frames and doors. Regulations 7(2) and 7(3) are about the external wall, while Principle D applies to the whole building. MHCLG FAQ 9 tends to treat curtain wall like window frames, while Principles D.5 and D.6 make a distinction.

Infill Panel question

However, as MHCLG FAQ 9 reiterates, the Insulated Infill Panels (IIPs) in external glazing systems are included in Regulation 7(2). Sometimes called "spandrel" panels, these opaque components are not excluded from Regulation 7(3) like the window or curtain wall frames they are glazed into. This is a practical nonsense for windows because the IIPs can fall away as the frames fail. However there are fire resisting options in curtain wall, which have long been available.

Product standards

BDM01 addresses the use of Insulated Infill Panels in Principles D.5 and D.6, making a distinction between two product standards and identifying the difficulty when windows, doors, and vents are combined into "screens" or "window wall":

- BS EN 14351-1:2006+A2:2016 *Windows and doors. Product standard, performance characteristics. Windows and external pedestrian doorsets*
- BS EN 13830:2015+A1:2020 *Curtain walling*

Principles D.5 and D.6 expect IIPs as part of the external wall to be universally non-combustible as Principle D.1. Additionally, Principle K promotes a protected zone of separation between openings in fire resisting compartment external walls, as BDM02-3.4, with openings for windows, doors, and vents manufactured to BS EN 14351-1 addressed as Principle K.4. IIPs should be non-combustible, may need to be fire resisting, and are part of the thermal design. It is worth considering thermal insulation more generally, before returning to the IIP question.

Thermal insulation

Thermal insulation is about Section 1(1)(b) of the Building Act 1984, in addition to Sections 1(1)(d) and (e). A sophisticated discussion about thermal performance focuses on comfort in buildings, as an aspect of health and life safety. Of technical importance when considering thermal performance are condensation risk and thermal conductivity. In the English statutory guidance, these are addressed as:

(E-AD-C)

Approved Document C: Site preparation and resistance to contaminates and moisture

(2004 as amended 2010 and 2013)

https://www.gov.uk/government/publications/site-preparation-and-resistance-to-contaminates-and-moisture-approved-document-c

(E-AD-L)

Approved Document L: Conservation of fuel and power

https://www.gov.uk/government/publications/conservation-of-fuel-and-power-approved-document-l

(E-AD-Lv1) Volume 1 – *Dwellings* (2021)

(E-AD-Lv2) Volume 2 – *Buildings other than dwellings* (2021)

Condensation risk

BDM01-16 (E-AD-C) is about condensation risk, which is part of the hygrothermal performance of construction, concerned with the control of condensation and the risks associated with toxic mould growth. The death of Awaab Ishak from the effects of inhaling toxic mould, and Coroner Joanne Kearsley's *Prevention of future deaths* report on 16 November 2022, need to be remembered when considering BDM01-16 (E-AD-F) *Approved Document F: Ventilation* in relation to Parts C and L of the statutory guidance.

https://www.judiciary.uk/prevention-of-future-death-reports/awaab-ishak-prevention-of-future-deaths-report/

These interrelated issues will be considered further in Principles M and N. (E-AD-C) is also about weathering and resistance to flood damage.

Insulation thickness

BDM01-16 (E-AD-L) in both Volumes is discussed in Principle D because the choice on the basis of thermal conductivity between non-combustible and combustible thermal insulation materials in products and systems affects construction thickness, and the thickness of insulation to building services.

Below ground, insulated construction thickness may be less problematic, particularly on a large site without hindrance at depth. Oxygen deprived combustible insulation below ground is not likely to be a concern as Principle D.1, allowing combustible forms of insulation in Principle D.2 that are unaffected by or protected from ground water, and which provide structural support in basements, foundations, and ground slabs.

Spatial coordination

It is important to correctly estimate the thickness of insulated external walls and roofs is prior to any planning application, when the "net-to-gross" ratio of lettable or saleable floor area to external plan area, is set for the building. It is also important to prepare the client early in the Project Brief of Work Stage 1, before thicker insulated construction affects the concept of Work Stage 2 and the spatial coordination of Work Stage 3.

"eco-thickness"

The investor may want to adopt Principle D.1 and maximise non-combustibility in the thermal insulation. However, this may mean accepting an "eco-thickness" that has commercial and aesthetic consequences. There may be pressure to shift the thermal insulation into Principle D.2, subject to limitations on the use of combustible insulation in statutory guidance.

Residential buildings

In BDM01-16 (E-AD-B) (2019 as amended 2020 and 2022) for England, only buildings with a storey height of over 18m are expected to have thermal insulation in the external wall of Class A2-s3,d2 or better to BS EN 13501-1, with the exception of residential buildings. For residential buildings, thermal insulation in the external wall is to be thought of as Class A2-s1,d0, when there is:

- a storey height of over 11m for Purpose Groups 1 and 2, and non-mandatory statutory guidance is followed; and
- a storey height of over 18m for "Relevant Buildings", and a legal requirement in Regulation 7(4), as BDM01-12.

In all other cases, the non-mandatory statutory guidance approves unlimited smoke (s) and the maximum of melting droplets (d), and there is no expected limit on the combustibility of insulation. This follows the incremental differentiation of residential buildings in 2018, 2019, 2020 and 2022, from the approach before Grenfell Tower fire in Paragraph 12.7 of BDM01-16 (E-AD-Bv2) (2006 as amended 2010 and 2013), where Class A2-s3,d2 or "limited combustibility" insulation was expected in any building with a storey height of over 18m. Between 2002 and 2006 a qualification on insulation material only in ventilated cavities of external walls in any building with a storey height of over 18m had affected specification.

Insulation location

Thermal insulation for flooring and pipework under BS EN 13501-1, or roofing under BS EN 13501-5, is classified differently. Internally combustible insulation is approved by statutory guidance in any building at any height.

Insulation selection

The non-combustible thermal insulations are Cellular Glass (CG), Stone Wool (SW), Glass Wool (GW), Fumed Silica (FS), Silica Aerogel (SA), and some configurations of Vacuum Insulation Panel (VIP). All other thermal insulation materials in products and systems are combustible. The problem of water absorption and consequential loss of thermal performance in some insulations is discussed in Principle N.

"Natural" insulation

The "natural" insulations of Cellulose Fibre (CF), Sheep's Wool (SHW) and Hemp Fibre (HF), are required in greater thicknesses for the same U-value because of a higher thermal conductivity. They are combustible.

Plastic insulation

The plastic insulations of Polystyrene (PS) in expanded (EPS) and extruded (XPS) variants, the related chemistry of foamed Polyurethane (PU) and Polyisocyanurate (PIR), and Phenolic Foam (PF) have a lower thermal conductivity and are generally lower cost. PU, PIR and PF are often manufactured with tissue or laminates of plastic and aluminium as facings. The facings avoid the plastic foams sticking to machinery in the manufacturing of boards.

Metal facings

Some metal facings may have enabled combustible insulation products to obtain Class 0 in BS 476 Parts 6 and 7 testing. Class 0 was a factor for insulation manufacturers when external walls included cavities for some cases in Diagram 40 of BDM01-16 (E-AD-Bv2)(2006 as amended 2010 and 2013), or when specifications following CWCT advice called for universal Class 0.

The facings may have a technical purpose, or even aesthetic characteristics when visible through open jointed or perforated cladding panels in rainscreen systems.

Thermal conductivity

Figure BDM01-10.4.2 shows that combustible plastic insulations are the market for thermal conductivities of 0.030 to 0.020 W/mK. Below this, there is a technical challenge in the potential market for "superinsulation" of lesser thicknesses for the same U-value. The current range of "superinsulation" on the market is unable to compete with plastic insulation on the price of the U-value alone.

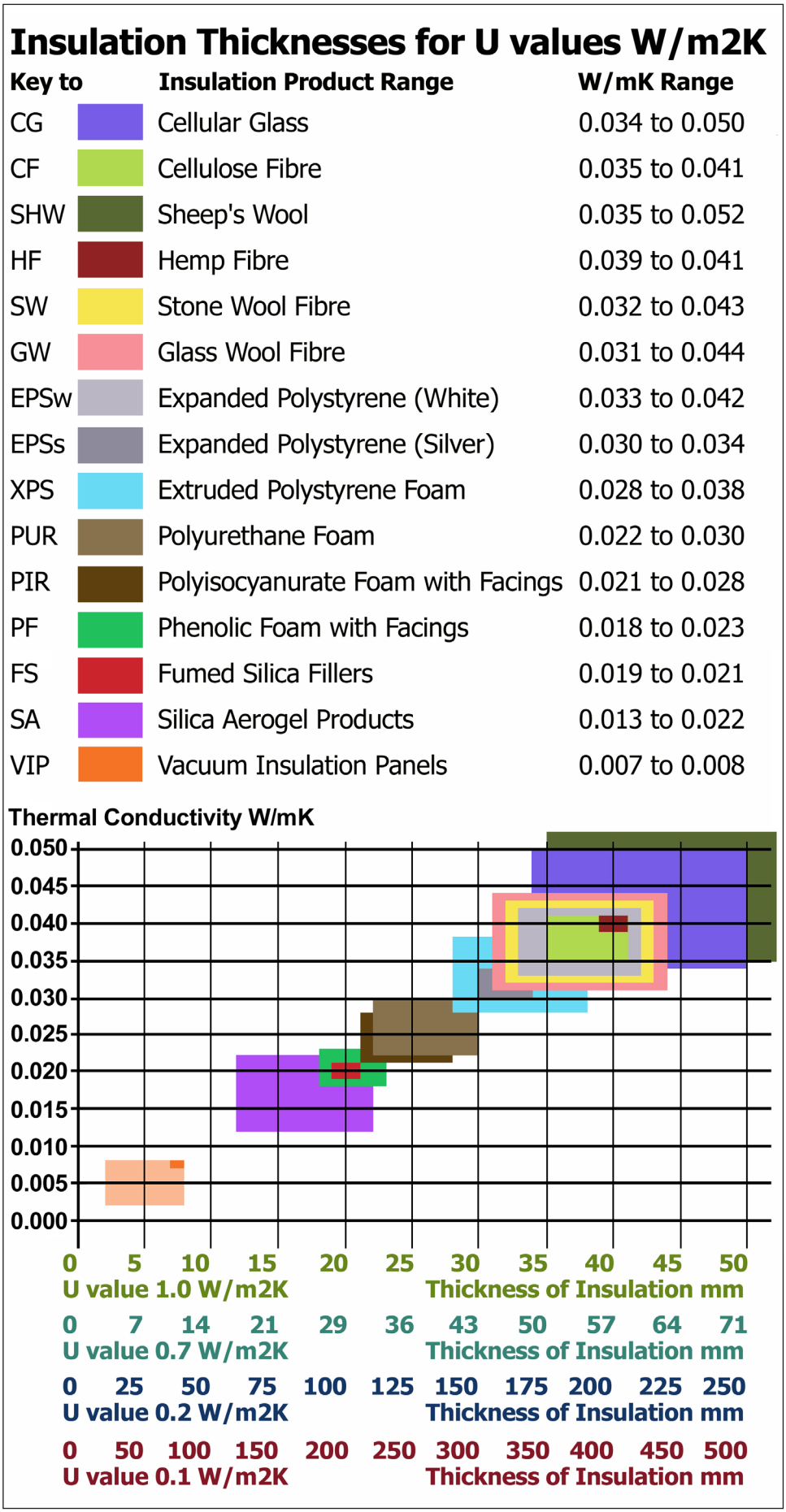

Figure BDM01-10.4.2 Insulation Thermal Conductivity Range – RISCAuthority

Fire resistance

SW and GW are both Mineral Wool (MW). Only SW is fire resisting, configured as fire stopping or cavity barriers, and of relevance to the discussion in Principle I. CG and GW are glass and will melt in fire, although they will not combust. The stone in SW is Basalt, which is melted and spun into a fibre in an industrial scale "candyfloss" machine. Variants of these three non-combustible materials are manufactured for particular technical applications.

Floor area value

FS and SA are non-combustible microporous "superinsulation" materials. They are expensive for a given U-value of insulation alone, compared to greater thicknesses of SW and GW, with CG being a mid-price option. However, a lower thermal conductivity in FS and SA means that valuable floor area is not lost in wall thickness on plan. In addition, heights can be reduced at floors, soffits, balconies, and roofs, or around architectural details such as window and door reveals.

Vacuum insulation

All insulations are shown at ambient air pressure. If microporous materials are evacuated, there is a performance leap to lower thermal conductivity and further reduced thickness for a given U-value of insulation alone. Some inorganic glass fibres, Fumed Silica, and Silica Aerogel can be processed into non-combustible cores to be held in a vacuum by a technical foil wrapping. This is much like blocks of vacuum packed coffee, only in larger and flatter formats for construction. Many technical foils are developed by the food packaging sector and some have then been adapted and advanced for insulation.

Consequently, a Vacuum Insulation Panel (VIP) is a prefabricated insulation product that can never be cut to size on site, as ambient air pressure insulations will allow.

Technical foil

However, the technical foils of a VIP may allow air to leak back into the panel, losing performance over time, or they may puncture for catastrophic failure. The VIP then reverts to the thermal conductivity of the microporous core material at ambient air pressure.

The technical foil laminates of plastic and aluminium can be heat sealed, and much Research and Development (R&D) has been invested internationally in trying to reduce the rate at which VIPs lose vacuum pressure and gain thermal conductivity. Manufacturers of plastic laminate foil favour Fumed Silica because it does not require such a low vacuum as glass fibre cores, and is more forgiving of air leakage, particularly through the heat sealed edges of the foil over time. But plastic laminates are combustible.

Stainless steel

Those favouring glass fibre cores are also able to favour welded stainless steel foils, which are now commercially available in coil widths of low thickness for fabrication with low energy welding. The stainless steel foils must resist corrosion but are less easily punctured. They are also non-combustible.

Infill Panel thickness

Insulated Infill Panels (IIPs) as Principles D.5 and D.6 are an obvious application for FS, SA, and non-combustible VIP fabrications.

However, IIPs are not considered by either Volume of (E-AD-L) as part of the external wall, while (E-AD-B) does consider IIPs as external wall. Consequently the IIP U-values are far higher, and the insulation product thinner, in glazed curtain wall, window or door systems. This allows lower cost and combustible higher thermal conductivity insulations into IIPs for glazed systems, while allowing the IIPs to improve on the system U-values that would otherwise be based on poorer thermally performing frames and Insulated Glass Units (IGUs).

AD-B and AD-L

IIPs are part of the external wall in Regulation 7(2) for Regulation 7(4) "Relevant Buildings" in Purpose Groups 1 and 2 with a Storey over 18m above ground. In both Volumes of (E-AD-B), IIPs are explicitly part of the external wall for all buildings with a Storey over 11m above ground. The implication is that IIPs are part of the external wall below that height too.

AD-A and AD-B

Differences in primary structure as the subject of (E-AD-A) affect how (E-AD-B) is resolved in architectural treatment of the external envelope. This is where structural, fire, and façade engineering meet in iterative design development through early Work Stages. Specialist consultant façade engineers often avoid roofing in their Scope of Services, though some undertake design of the external envelope as a whole. Simpler envelopes do not require façade engineers, but external walls are increasingly complex technologies in which weather tightness requires understanding and thermal performance is taken to extremes.

Exclusions in 7(3)

Other Regulation 7(3) exclusions of thermal break materials necessary to satisfy the thermal bridging requirements of Part L of Schedule 1 of the Building Regulations 2010, as BDM01-11, include seals, gaskets, fixings, sealants and backer rods. These are likely to be combustible.

By necessity, intumescent materials in products and systems have to react to fire in their expansion to fill gaps. Such materials are not tested and classified to BS EN 13501-1, and cannot obtain Class A2-s1,d0. They are also excluded in Regulation 7(3). Yet they must intumesce to assist other products to achieve fire resistance. Intumescent materials present a significant frontier of research and development.

Internal finishes

The MHCLG FAQ 8 excludes internal finishes from the meaning of "external wall" in Regulation 7(2). Principle D is concerned with the whole building, whether defined as a "Relevant Building" as Regulation 7(4) or not. Timber is a common choice for architraves and skirtings, and joinery products are widely used in fit out.

Green roofs or walls

In 2013, the MHCLG published *Fire performance of green roofs and walls*, referred to in Paragraph 10.7 of Volume 1 and Paragraph 12.7 of Volume 2 of BDM01-16 (E-AD-B). Despite reproducing Diagram 40 from (E-AD-Bv2) (2006 as amended 2010 and 2013) on page 26, the guidance insists on page 27:

"Approved Document B also states that in a building with a storey 18m or more above ground level any material used in the external wall construction should be of limited combustibility."

https://www.gov.uk/government/publications/fire-performance-of-green-roofs-and-walls

2013 guidance error

Neither Volume of (E-AD-B) has referred to "limited combustibility" since 2019, and Diagram 40 never expected better than National Class 0 or European Class B. The error in the 2013 guidance is recognised by manufacturers who focus on a Class B market. Testing under BS EN 13501-1, the wet soil and moist plants protect "fire retarded" but combustible plastic planters, and a Class B-s2,d0 is then achievable. Ranges of non-combustible planters are to be encouraged.

Soil and plants

It would be technically unacceptable to test wet thermal insulation to improve the classification, either at product or system scales. Testing of green walls to BS 8414 at a system scale test for the external wall build-up has the same problem of wet soil and moist plants. It is advisable to insist upon Principle D.1 for the insulation, supports, and planters, even if the irrigation system is combustible, accounting for the potential for soil to dry out and plants to die or become overgrown.

Green roofs and walls are further addressed as Principles L.4, M.9, W.5, and W.6, and maintained as Principle Y.

10.5 Principle E – Anticipate Arson Attempts

Principle E – Anticipate Arson Attempts

Introduce measures to prevent, so far as reasonably practicable, an anticipated arson attack from an external fire source either thrown or positioned to cause damage anywhere within and around the building, particularly at lower storeys.

E.1 Opportunity for climbing the external wall of the building is frustrated

E.2 Prioritise non-combustible construction as Principle D.1 at low level

E.3 Perimeter security is provided to the site with improved visibility

E.4 Fuel storage is addressed and protected as a potential target for arson

E.5 Permanent external storage controlled by the facilities manager

E.6 Temporary external storage controlled by the "Principal Contractor"

E.7 Temporary construction works and construction vehicles are secured

E.8 Prospects of arson during construction addressed as Principle B.8

E.9 Solid waste refuse chutes and storage facilities are secure

E.10 Security in all Purpose Groups not only Dwellings as Purpose Group 1

E.11 Locations for anti-burglar or anti-vandal laminated glass

E.12 Security alarms and camera systems are installed and maintained

1984 Building Act

The power to make Building Regulations is currently exercised by the Secretary of State of DLUHC, as established in Section 1 of the Building Act 1984.

https://www.legislation.gov.uk/ukpga/1984/55/section/1

After health and life safety in Section 1(1)(a) of the Building Act 1984, the power to make Building Regulations is extended for the purposes of:

(b) furthering the conservation of fuel and power

(c) preventing waste, undue consumption, misuse or contamination of water

(d) furthering the protection or enhancement of the environment

(f) furthering the prevention or detection of crime.

Statutory guidance

These purposes are given practical meaning throughout the statutory guidance, as discussed as BDM01-5. They all might relate to the problem of arson, which is frustrated through the use of non-combustible materials as Principle D.1. Parts of the English statutory guidance as BDM01-16 also have relevance:

(E-AD-J)

Approved Document J: Combustion appliances and fuel storage systems

(2010 as amended 2010, 2013 and 2022)

https://www.gov.uk/government/publications/combustion-appliances-and-fuel-storage-systems-approved-document-j

(E-AD-Q)

Approved Document Q: Security – Dwellings

(2015)

https://www.gov.uk/government/publications/security-in-dwellings-approved-document-q

Fuel storage is specifically addressed as a potential target for arson and protected by security for every Purpose Group as Principle E.4. This is additional to compliance with provisions in BDM01-16 (E-AD-J). Security is further addressed for all Purpose Groups as Principle E.10, which goes beyond any limitation of security to Dwellings as BDM01-16 (E-AD-Q). Security is no substitute for the deployment of non-combustible construction in a building, but it is an important aspect of the Resilience Strategy when combustible materials, either in the building as Principle D.2 or in the contents, require protection from attack.

Legal definition

The crime of arson is defined in Section 1 of the Criminal Damage Act 1971.

https://www.legislation.gov.uk/ukpga/1971/48/contents

In Scotland, "wilful fire-raising" and "culpable and reckless fire-raising" are two separate common law offences. The charge of wilful fire-raising and in the alternative culpable and reckless fire-raising may be brought by the Crown, leaving the jury to decide which crime, if any, they convict the accused of committing.

The shorthand of arson is used, accepting the Scottish legal difference. Where arson is not a question of recklessness but is instead wilful, it is intentional or deliberate, being either opportunistic or premeditated.

Publications

Arson is a problem that has grown since the 1950s. Where there is injury or death as a result, the crime has a seriousness beyond loss of insurable property. Over 40% of all fires in industry and commerce, and over 20% of fires in residential properties, are now lit deliberately, sometimes as part of an attempt by building owners to defraud their insurer. Recklessness that causes a larger fire event may cause the building owner and their insurer great difficulty. However, other opportunistic or premeditated arsonists can be frustrated in practical ways.

A number of FPA and RISCAuthority publications may be referred to:

- Adair Lewis, FPA and RISCAuthority, *The Prevention and Control of Arson*, Third Edition 2012, first published 1999, sponsored by Gerda
- BDM10 *Code of practice for the protection of empty buildings: fire safety and security* https://www.thefpa.co.uk/resource-download/242
- RC48 *Arson Prevention: The protection of premises from deliberate fire raising* – Version 01 – 2010 https://www.thefpa.co.uk/resource-download/349
- S20 *Security: Essential principles for the security of property* – Version 01 – 2012 https://www.thefpa.co.uk/resource-download/283
- S31 *Unauthorised occupation of non-residential premises – guide to managing the risk* – Version 01 – 2017 https://www.thefpa.co.uk/resource-download/293

BPPP resources

Patterns in arson vary depending on the Purpose Group and the occupational issues discussed as Principle G. The Business and Property Protection Portal (BPPP) utilises "big data" and real-life statistical sources to produce a risk report for any business type and UK postcode. The predictive technology includes an analysis of the perils of arson and security, and scopes average costs in the event of fire damage. Complete the form to generate a risk report or obtain guidance.

http://fpa.bppp.riscauthority.co.uk/

Other search categories are available to investigate through the BPPP, which may have relevance in addressing issues raised in other Principles. These are not member only services. They may be freely used in developing the Resilience Strategy as Principle A, or in consultation with insurers as Principle B.

SPD resources

Secured by Design (SBD) is the official police security initiative that works to improve the security of buildings and their immediate surroundings to provide safe places to live, work, shop, and visit. SBD provides a product based accreditation scheme in the Police Preferred Specification (PPS), as a recognised standard for all security products that can deter and reduce crime.

https://www.securedbydesign.com/member-companies/police-preferred-specification-explained

SBD guidance for clients and their consultants is available:

https://www.securedbydesign.com/guidance/design-guides

An interactive design guide is provided:

https://www.securedbydesign.com/guidance/interactive-design-guide

SPD provides a national building approval scheme for residential developments that augments BDM01-16 (E-AD-Q).

https://www.securedbydesign.com/services/nba-member

JCoP 2022

The *JCoP on Fire Prevention on Construction Sites* 2022, as Principle B.8, can be read with the SPD *Construction Site Security Guide* 2021.

https://www.securedbydesign.com/images/CONSTRUCTION_SITE_SECURITY_GUIDE_A4_8pp.pdf

https://www.thefpa.co.uk/resource-download/607

10.6 Principle F – Monitor Building Services

Principle F – Monitor Building Services

Ensure all building services, including local sources of renewable energy or mains utilities connections, are designed, installed, commissioned, and maintained to prevent them being a cause of fire ignition, smoke spread, or water damage.

F.1 Building services are specified and procured to support Principles D, I and J

F.2 Smoke ventilation shafts tested to achieve a Smoke Leakage (S) rate

F.3 Drainage systems and water mains in separate waterproof service risers

F.4 External services or drainage through service risers to prevent climbing

F.5 Building services are maintained in working order as Principle Y

F.6 Combustion appliances and fuel storage comply with Building Regulations

F.7 Gas services avoiding protected escape routes in ventilated service risers

F.8 Gas main isolation valves agreed with the Fire and Rescue Service

F.9 Hydrogen technologies require specialist guidance in the Resilience Strategy

F.10 Electrical services and meters in risers are separate from gas services

F.11 Electrical installations comply with the Building Regulations

F.12 Electricity generation requires specialist guidance in the Resilience Strategy

F.13 Electrical main isolation switches agreed with the Fire and Rescue Service

F.14 Emergency lighting, illuminated fire signage, and Fire Control Panels

F.15 Hot water services require specialist guidance in the Resilience Strategy

F.16 Fire door hold-open or free-swing devices operate on first smoke detection

F.17 Smoke systems, fire curtains, fire shutters, and closing devices maintained

F.18 Protection against lightning strike as Principle M.8 protects building services

F.19 Building services are verified through recorded information as Principle V

F.20 Moveable heating and ventilation appliances are unnecessary or managed

1984 Building Act

The power to make Building Regulations is currently exercised by the Secretary of State of DLUHC, as established in Section 1 of the Building Act 1984.

https://www.legislation.gov.uk/ukpga/1984/55/section/1

After health and life safety in Section 1(1)(a) of the Building Act 1984, the power to make Building Regulations is extended for the purposes of:

(b) furthering the conservation of fuel and power

(c) preventing waste, undue consumption, misuse or contamination of water

(d) furthering the protection or enhancement of the environment

(e) facilitating sustainable development.

Statutory guidance

These purposes are given practical meaning throughout the statutory guidance, discussed as BDM01-5. Of relevance when considering building services are the following Parts of statutory guidance in England, as BDM01-16:

(E-AD-G)

Approved Document G: Sanitation, hot water safety and water efficiency

(2015 as amended 2016)

https://www.gov.uk/government/publications/sanitation-hot-water-safety-and-water-efficiency-approved-document-g

(E-AD-H)

Approved Document H: Drainage and waste disposal

(2015)

https://www.gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h

(E-AD-J)

Approved Document J: Combustion appliances and fuel storage systems

(2010 as amended 2010, 2013 and 2022)

https://www.gov.uk/government/publications/combustion-appliances-and-fuel-storage-systems-approved-document-j

(E-AD-P)

Approved Document P: Electrical safety – Dwellings

(2013)

https://www.gov.uk/government/publications/electrical-safety-approved-document-p

For Principle F.2, specifically concerned with smoke ventilation shafts constructed as part of the fire resisting compartmentation, it is useful to consider the discipline of air leakage testing the completed building envelope. This is described in Volume 1 Dwellings and Volume 2 Buildings other than dwellings of:

(E-AD-L)

Approved Document L: Conservation of fuel and power

https://www.gov.uk/government/publications/conservation-of-fuel-and-power-approved-document-l

(E-AD-Lv1) Volume 1 – *Dwellings* (2021)

(E-AD-Lv2) Volume 2 – *Buildings other than dwellings* (2021)

The legal requirements for both Volumes of BDM01-16 (E-AD-L) are L1 and L2 in Part L of Schedule 1 of the Building Regulations 2010, as BDM01-11. This is not to be confused with the numbering of the two Volumes. L1 and L2 in Schedule 1 are Requirements, not the Volume numbers of statutory guidance.

Regulation 43

Requirement L1(a)(i) applies to both Volumes of BDM01-16 (E-AD-L). It requires reasonable provision shall be made for the conservation of fuel and power in buildings by limiting heat gains and losses through thermal elements and other parts of the building fabric. This includes air tightness. Whether heating or cooling the building, air leakage through the building fabric is to be limited. (E-AD-L) further refers to Regulation 43 of the Building Regulations 2010, requiring pressure testing of the whole building fabric. Regulation 43 pressure testing for air tightness is predicated on Regulation 26 CO_2 emission rates for new buildings other than Dwellings and Regulation 26A fabric energy efficiency rates for Dwellings.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/26

https://www.legislation.gov.uk/uksi/2010/2214/regulation/26A

https://www.legislation.gov.uk/uksi/2010/2214/regulation/43

Regulation 43(2)(a)(ii) allows the pressure testing to be carried out in accordance with a procedure approved by the Secretary of State.

Regulation 43(4) goes further. It states that a local authority is authorised to accept, as evidence that the requirements of 43(2)(a)(ii) have been satisfied, a certificate to that effect

by a person who is registered by Elmhurst Energy Systems Limited or the Air Tightness Testing and Measurement Association (ATTMA) in respect of pressure testing for the air tightness of buildings.

https://www.gov.uk/government/publications/regulation-43-of-the-building-regulations-2010

https://www.elmhurstenergyconsultancy.co.uk/air-tightness-testing

https://www.bcta.group/attma/what-is-air-tightness-testing/

Building enclosure

ATTMA promote a "Building Enclosure Commissioning" process for clients.

https://www.bcta.group/attma/2022/how-to-plan-and-build-for-air-tightness/

CIBSE TM23

The testing is based on CIBSE TM23 *Testing buildings for air leakage* (2022)

https://www.cibse.org/knowledge-research/knowledge-portal/tm23-testing-buildings-for-air-leakage-2022

"Infiltration and air leakage is the uncontrolled movement of air through a building envelope or component due to the porosity of building fabric materials, interfaces between materials and components and imperfections in the construction of the building. Infiltration refers to natural conditions, while air leakage refers to air movement in a building due to a pressure differential."

Two measures for air tightness are used, known as "Air Permeability" and "Air Change Per Hour".

Air Permeability

The volume of air (m^3) per hour (h) at an imposed pressure differential of 50 Pascals (Pa) is divided by the building envelope area (m^2). This results in an "Air Permeability" measured in $m^3/h.m^2$ @ 50 Pa. This is the preferred measure in the statutory guidance of the four devolved administrations of the UK.

Air Change Per Hour

The volume of air (m^3) per hour (h) at an imposed pressure differential of 50 Pascals (Pa) divided by the building volume (m^3). This results in an "Air Change Per Hour" measured in $m^3/h.m^3$ @ 50 Pa, sometimes expressed as h-1, or ACH.

Area to Volume ratio

The measure of air leakage as air permeability relates to the building envelope area in contrast to the volume of the building used to determine air change, and both are per hour. The ratio of insulated external surface area to conditioned internal volume of the building matters, and varies with architectural form.

Limits in guidance

Table 4.1 in both Volumes of BDM01-16 (E-AD-L) limits the measurement of air permeability to 8.0 $m^3/h.m^2$ @ 50 Pa, while dwellings are specified in Table 1.1 of Volume 1 to <5.0 $m^3/h.m^2$ @ 50 Pa. Many developments specify and achieve low air permeability of 1.0 $m^3/h.m^2$ @ 50 Pa.

Passivhaus

The Passivhaus standard developments that prioritise ACH of 0.6 $m^3/h.m^3$ @ 50 Pa often achieve 0.3 $m^3/h.m^3$ @ 50 Pa across all Purpose Groups. Some of the exemplary housing approaching "zero air leakage" of 0.05 $m^3/h.m^3$ @ 50 Pa.

In both measures, obvious defects causing locally high leakage are identified in the testing and corrected to the point where the level of leakage is general. The effects of movements in the construction have to be considered and addressed.

Smoke tightness

The question of air tightness for the whole building envelope is a matter for consultants through the design phase and contractors through the construction phase. While air leakage through the external walls and roofs is appreciated, quantified, and tested in response to Regulation 43, smoke leakage through smoke ventilation shafts or other compartmentation is not considered in the Building Regulations 2010 as an aspect of fire resistance.

Smoke shaft testing

BDM01 expects fire resisting smoke ventilation shafts to be smoke tightness tested as Principle F.2. This requires explanation, given Principle F for building services precedes Principle I for fire resisting compartmentation. The reader may find it useful to look ahead to BDM01-10.9, for the supporting notes to Principle I, before returning here, to BDM01-10.6. Conversely continuing to read here may be an introduction to fire resistant construction, which should help explain the purpose and meaning of Principle F.2 for building services. While interdependent, the building services design that includes smoke control systems may predetermine performance requirements that must be met in compartment floors and walls.

BS EN 13501-2

All building services must be integrated into the passive fire protection strategy of compartmentation, defined in terms of compartment floor area (m2) and the fire resistance of compartment floors and walls (Minutes). Fire resistance tends to be specified to BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*. The categories of Stability (R), Integrity (E), and Insulation (I) are established for fire resistant construction.

REI in Minutes

A structure engineered to achieve a period of Stability (R) as Principle H, relating to compartment floors requiring a period of Stability, Integrity, and Insulation (REI), or non-loadbearing compartment walls Integrity and Insulation (EI), allows time for evacuation of occupants and firefighters before collapse, as Principle C.

Extensive smoke spread through leakage (S) can greatly increase property damage, even if heat and flame are better limited to the compartment of origin through (EI) fire resistance.

Anticipating BDM02

By agreement with insurers, fire resistance can be enhanced to give a longer period for property protection. BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022, draws all the enhancements together, and relates directly to the *LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 Fixed firefighting systems*, which is valued by insurers, as Principle I and BDM01-10.9.

However BS EN 13501-2 is not limited to the (REI) classifications. The fire resistance standard is also concerned with smoke leakage, as the ability of an element of construction "... to reduce the passage of hot and/or cold gases or smoke from one side of the element to the other to below specified levels."

REIS in Minutes

Smoke Leakage (S) is considered for fire doors and doorsets, or fire curtains and shutters. It is less often recognised as a category for compartment floors and walls into which those opening elements of construction are fitted. Compartment floors and walls should not leak hot or cold smoke either.

For health and life safety under the law, it might be expected that compartment floors and walls are more routinely classified in terms of (REIS) or (EIS). However, the (S) category is often undefined for floors and walls even when specified for doors, curtains, and shutters.

BS EN 13501-4

In BS EN 13501-2, Class S_a considers smoke leakage at ambient temperature only, while S_{200} considers smoke leakage at both ambient temperature and at 200°C. Smoke can be far hotter, of course, with temperatures of 600°C anticipated in BS EN 13501-4:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests on components of smoke control systems*. Yet there is no mention of S_{600} in BS EN 13501-2.

Smoke temperature

Cold, choking and disorienting smoke prevents escape and does not need to be 200°C. Degrees of burns occur below 100°C. Smoke at 600°C cannot be survived for long even by firefighters with breathing apparatus and protective equipment.

Clear escape routes

Smoke control should minimally maintain the escape routes and firefighter access clear of smoke for the period of time necessary for the evacuation strategy. This is a protracted period when escape is phased rather than simultaneous, or when a "Stay Put" policy is adopted. As discussed in BDM01-10.3 for Principle C, the "Stay Put" policy is being reconsidered since the Grenfell Tower fire, because delayed self-evacuation requires extended smoke control through compartmentation and ventilation. Recognising internal smoke ventilation measures can be overwhelmed by simultaneous fires in several compartments caused by fire in a combustible external wall. Principles D, K, and L are necessary to avoid compartmentation breach and the production of overwhelming quantities of smoke.

Four strategies

As Principle C.15, four smoke control strategies are available, with the Fire and Rescue Service preferring an "AA" automatic activation rather than the necessity for "MA" manual intervention:

- Natural Opening Smoke Ventilation of escape stairs and corridors
- Mechanical Pressurisation of escape stairs
- Natural Smoke and Heat Exhaust Ventilation (N-SHEV)
- Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV)

Natural vents

Openings for natural smoke ventilation require smoke buoyancy assisted by cross ventilation which is subject to adverse wind conditions. The "aerodynamic free area", ignoring wind speed and direction complications, requires testing the specific Automated Opening Vent (AOV) to establish the "coefficient of discharge" for the geometric opening arrangement. This affects the fenestration of windows or doors used as AOVs. However, diluting, cooling and dispersing smoke increases the quantity while contaminating incoming fresh air. Natural opening smoke ventilation is a self-defeating strategy in all but the smallest of buildings.

Keeping smoke undiluted so far as reasonably practicable controls the smoke that does enter escape stairs and corridors.

Pressurisation

Protected escape stairs with any lobbies can instead be mechanically pressurised to maintain a low pressure differential before the corridor of not less than 50 Pa ± 10%. The force on a fire door handle shall not exceed 45 N, according to BS 9999:2017 *Fire safety in the design, management and use of buildings*. The strategy of escape stair pressurisation is sufficient in open plan compartment arrangements, but any escape corridor requires additional smoke ventilation.

SHEV systems

Smoke and Heat Exhaust Ventilation (SHEV) may be provided with or without stair pressurisation. The vertical smoke ventilation shaft is a vital element of construction. It runs vertically from the lowest level intake through compartment floors to the roof.

The constructed shaft must be specified to an (EIS) classification, designed and built to be smoketight.

Natural SHEV

Naturally ventilated SHEV systems rely upon the "stack effect" of buoyant hot smoke. On a calm day there is low internal pressure that will not exceed 50 Pa ± 10%. However, an N-SHEV is subject to adverse wind conditions at the intake and the roof. A mechanically ventilated SHEV is unaffected by weather.

Mechanical SHEV

M-SHEV fans can be configured for extraction only on each and every smoke ventilation shaft, while the fans on pairs of smoke ventilation shafts at opposite ends of corridors can use a reversible "push-pull" configuration responding to internal detection. However, if there is too much "push" and not enough "pull", unintended corridor pressurisation may start to force smoke into escape stairs, defeating any stair pressurisation. CFD models can be unrealistic. Simpler smoke extraction may be more reliable.

Mechanical components are tested for 30, 60, 90 or 120 Minutes at either 500, 1000 or 1500 Pa pressures for classification to BS EN 13501-4. In some cases, (EIS) fire resistance of 240 Minutes may be required, perhaps necessitating an engineering assessment.

A smoke extraction pressure for an M-SHEV requires greater smoketightness in the compartment construction than the 50 Pa for an N-SHEV, pressurised stair, or other compartments naturally smoke ventilated through openings.

SHEV duct leakage

BS EN 13501-4 expects smoke leakage of less than 5.0 $m^3/h.m^2$ for ducts, while the smoke leakage limit for Class S smoke control dampers is 200 $m^3/h.m^2$ at ambient temperature and 600°C. This is a maximum, and the operation of the extract fans in a fire event must anticipate leakage. The duct smoketightness of 5.0 $m^3/h.m^2$ @ 500, 1000 or 1500 Pa might inform shaft construction.

Shaft construction

M-SHEV shaft walls built from non-combustible boards on light framing, rather than concrete or masonry, may not achieve the duct-equivalent smoketightness. Alternatively, fire resisting ductwork will achieve the (S) performance for the M-SHEV, with the shaft specified to a verifiable (EIS). However, physical access is required around the ducts to install and inspect them in an enclosed space.

Conclusion

In conclusion, Smoke Leakage (S) for compartmentation might be specified as less than 2.0 $m^3/h.m^2$ @ 50 Pa, except for an M-SHEV, which shall achieve less than 5.0 $m^3/h.m^2$ @ 500, 1000 or 1500 Pa in either the shaft compartment construction without ductwork, or the fire resisting ductwork. The constructions are tested from both sides at ambient and the expected fire temperature, which may be 600°C.

Principle F.2 then relates to other Principles and is expressed as:

Principle F.2

Smoke ventilation shafts as Principle C.17, constructed as Principle D.12 using construction tested for viability as Principle S.7, and completed as part of fire resisting compartmentation as Principle I.17, are tested for smoke tightness, regardless of whether shafts are constructed wholly onsite or constructed offsite and sealed onsite, to achieve a Smoke Leakage (S) rate of:

- <2.0 $m^3/h.m^2$ @ 50 Pa for:
  - Natural Smoke and Heat Exhaust Ventilation (N-SHEV)
  - Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV) with fire resisting ductwork achieving (S) of <5.0 $m^3/h.m^2$ @ 500, 1000 or 1500 Pa

- <5.0 $m^3/h.m^2$ @ 500, 1000 or 1500 Pa for:
  - Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV) with the shaft construction only instead of fire resisting ductwork;

Smoke tightness at 50 Pa may be tested using the method in CIBSE TM23 *Testing buildings for air leakage*, referred to in both Volumes of BDM01-16 (E-AD-L) for assessing Regulation 43 of the Building Regulations 2010. For M-SHEV shaft testing at 500, 1000 or 1500 Pa, a more onerous test method will be required. It is not obvious what that test method may be, as it is a higher pressure test of construction and not a test of ductwork.

SCA guidance

Smoke ventilation shafts constructed within the compartmentation remain an alternative to the use of fire resisting ducts in M-SHEV smoke control systems provided the walls can be built without excessive smoke leakage. In December 2020, the Smoke Control Association (SCA) published WP001 *Guidance on the Specification of Products and Systems for Smoke Shafts*, among their other resources.

https://www.smokecontrol.org.uk/resources

BS EN 13501-3

The fire resisting ducts and dampers in smoke control systems are addressed by BS EN 13501-3:2005+A1:2009 *Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers*. However, there is an important distinction between fire dampers and smoke control dampers that requires recognition, as BDM01-14.

https://www.ventilationfiresmoke.com/smoke-control-dampers-book

Integrated detection

Parts of BS 7273 *Code of practice for the operation of fire protection measures* as Principle R.2, and smoke control system components as Principle R.2, should be installed and integrated with the detection and alarm system.

Firestopping services

In 2020, five trade associations collaborated in an exemplary way to jointly publish *Firestopping of service penetrations – best practice in design and installation*. This relates explicitly to the *RIBA Plan of Work 2020*.

https://www.thebesa.com/technical/publications-knowledge/fire-stopping-of-service-penetrations/

The idea of relating BDM01 to the *RIBA Plan of Work 2020* came from reading *Firestopping of service penetrations*. This industry guide is essential reading for understanding Principle F as a question of monitoring building services to integrate with compartmentation as Principle I. The collaborating trade associations were:

- Association for Specialist Fire Protection (ASFP)
  https://asfp.org.uk/
- Building Engineering Services Association (BESA)
  https://www.thebesa.com/
- Building Services Research and Information Association (BSRIA)
  https://www.bsria.com/uk/
- Finishes and Interiors Sector (FIS)
  https://www.thefis.org/
- Gypsum Products Development Association (GPDA)
  https://gpda.com/

Quality of materials

These trade associations are also working to improve compliance with Regulation 7(1), discussed as Principle T for materials quality and Principle U for competent work, to consequently improve Regulation 38 Fire Safety Information exchange discussed as Principle V.

BDM06 in future

The collaborative *Firestopping of service penetrations – best practice in design and installation* further suggests that BDM06 *Fire protection of buildings – Core Document – Protection of openings and service penetrations from fire* may be subsumed into BDM01 Essential Principles.

https://www.thefpa.co.uk/resource-download/239

Parts of the current BDM06 that explicitly address other advances in duct, pipe, and cable service installations as Principle F, with a discussion of penetrations through compartment walls and floors to be fire stopped as Principle I.14, may be brought into BDM01. A separately updated BDM06 may discuss the subject of internal compartment openings providing access as Principles I.17 to I.24.

Requirement P1

11.14 Part P Electrical safety in Schedule 1 Requirements of the Building Regulations 2010, as amended, contains Requirement P1, that addresses electrical design and installation, saying:

"Reasonable provision shall be made in the design and installation of electrical installations in order to protect persons operating, maintaining or altering the installations from fire or injury."

All Purpose Groups

This is given practical meaning for dwellings in *Approved Document P: Electrical safety – Dwellings* (2013), as BDM01-16 (E-AD-P). However, the fire safety of electrical design and installation shall be considered in buildings of all Purpose Groups, as Part of the Resilience Strategy, as Principle A.

Cable combustibility

The combustibility of cabling is addressed in the BS EN 13501 series as:

- BS EN 13501-6:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests on power, control and communication cables*

Low smoke cabling

Low smoke emission cables should be specified and procured as Principle T, with reference to the British Approvals Service for Electrical Cables (BASEC) guidance on classifications, starting with the *Fire testing, UKCA and CPR guide*.

https://www.basec.org.uk/about/about-basec/

https://www.basec.org.uk/resources/why-use-basec-approved-cable/

https://www.basec.org.uk/download-your-fire-and-cpr-guide/

Emergency lighting

Emergency lighting and any associated illuminated fire signage installation agreed with the Fire and Rescue Service as Principle C shall be to BS 5266-1:2016 *Emergency lighting. Code of practice for the emergency lighting of premises*, and the subsequent Parts of the BS 5266 series. The arrangement will require advice by the building owner or operator, or their facilities manager as Principle W.

Plastic pipework

Almost disregarded in the discussion of MMC, solvent welded and "push-fit" plastic pipework has transformed "plumbing", just as copper, steel, and cast iron pipework earlier replaced lead pipework as a trade. The earlier metal transformation improved health and life safety in the quality of potable water and the ease of foul water disposal. The proliferation of plastics in pipework has created a fire and smoke risk, and may also increase the prospect of escape of water events through shorter service life. The risk of a fire event can best be managed through the design of compartmented service risers as Principle I. It is better to avoid running plastic pipework through inaccessible cavities.

Categories of cavity

There are four categories of cavity construction to consider, for all building services distributions of ducts, pipes, and cables:

- Cavities concealed by non-fire resisting internal construction [D and F]
- Cavities within roof construction [I]
- Cavities within internal compartment walls and floors [J]
- Cavities within external wall construction [J and K]

Several Principles throughout BDM01 relate to the four categories of cavity, but the [brackets] refer to Principles in which cavities are most obviously discussed.

Services in cavities

Building services are often routed or distributed in cavities concealed by non-fire resisting internal construction below raised floors, behind wall linings, above suspended ceilings, or above ceilings below a roof. The non-fire resisting internal construction provides interior finishes to the accommodation within the fire resisting construction of internal compartment walls and floors, where building services are to be concealed. Otherwise, the fire resisting construction of internal compartment walls and floors provides interior finishes to the accommodation and the building services are exposed to view.

This is quite different to the unacceptable case where building services are routed or distributed through cavities within internal compartment walls and floors. Any cavities within internal compartment walls and floors should be controlled as Principle J. The fire resisting construction of internal compartmentation should only be penetrated by building services installation perpendicular to walls and floors, and fire stopped as Principle I.

Service risers

Service riser compartments of fire resisting construction are to be provided where building services are to be routed or distributed vertically through the building without fire stopping horizontally at every compartment floor level. Fire resisting construction extends service riser compartments horizontally. All vertical service risers and horizontal extensions require fire resisting access panels.

External services

Cavities within external wall and roof construction should not be used as a route for distribution of building services. Whether the external walls and roofs are cavity construction or not, there are options for internal concealment of building services where external distribution routes are designed out to anticipate arson attempts as Principle E, or for aesthetic reasons.

Where building services are to be routed or distributed vertically through the building with fire stopping horizontally at every compartment floor level, they may be concealed by non-fire resisting internal construction.

Where building services are to be routed or distributed vertically through the building without fire stopping horizontally at every compartment floor level, accessible fire resisting service risers should be provided full height between openings in compartment floors, interfacing with the external wall or roof construction. The extent of protected and unprotected zones of both wall and roof should not compromise the service riser

compartmentation, and the external wall and roof should maintain the fire resistance of the interfacing vertical service riser or horizontal extension.

The fire resisting construction of external walls and roofs, whether cavity construction or not, should only be penetrated by building services installation perpendicular to walls and floors, and fire stopped as Principle I.

Lloyd's Building

Lloyd's Building did not adopt conventional internal services distribution. The horizontal services distribution on the soffit means penetrations to the raised floor of the compartment above. Those services are distributed externally, expressed as architecture, with insulated pipework and ductwork run vertically to plant room levels, including the large services towers. This requires a significant maintenance commitment for services exposed to the weather over time. The range of ancillary accommodation Modules is incorporated into the external primary structure, with prefabricated escape stairs and external glass lifts. Lloyd's Building also has back up electricity generators in the basement, with a cluster of external flues. The whole is a Grade 1 Listed Building central to the City of London.

https://historicengland.org.uk/listing/the-list/list-entry/1405493

Class S not Class G

The Class (S) consideration for smoke is different to "Soot" as Class (G), considered in BS EN 13501-2 at 1000°C for open fire and chimney flue constructions, which may be built into compartment walls and through compartment floors.

Flue integration

Contemporary open fire and chimney flue constructions are a complement to twenty first century building services, while part of the legacy of heritage buildings. Many of the buildings in the Purpose Groups discussed in BDM02 2022 no longer depend laboriously upon open solid fuel fires, but instead have gas heating boilers and building services plant rooms, which involve other monitoring issues for fire safety. In new developments there are service flues and terminals penetrating through and sealed into roof and wall construction. However, there is a legacy of existing buildings with architectural chimney stacks, and a fashionable preference for contemporary open solid fuel fires and stoves. This requires attention to non-combustible construction as Principle D.

Part J consideration

BDM01-11.9 Part J Combustion appliances and fuel storage systems in Schedule 1 Requirements of the Building Regulations 2010, as amended, contains Requirements J4 and J5, that address the ignition risk of open solid fuel fires and gas heating boilers, with their flues and chimneys. This is given practical meaning in *Approved Document J: Combustion appliances and fuel storage systems* (2010 as amended 2010, 2013 and 2022), as BDM01-16 (E-AD-J).

Requirement J4

Protection of the building is addressed in Requirement J4 for fixed combustion appliances, including incinerators, which says:

"Combustion appliances and flue-pipes shall be so installed, and fireplaces and chimneys shall be so constructed and installed, as to reduce to a reasonable level the risk of people suffering burns or the building catching fire in consequence of their use."

Requirement J5

Provision of information is addressed in Requirement J5, which might also relate to the Regulation 38 Fire Safety Information exchange expected in the Building Regulations 2010, as amended, as Principle V. Requirement J5 says:

"Where a hearth, fireplace, flue or chimney is provided or extended, a durable notice containing information on the performance capabilities of the hearth, fireplace, flue or chimney shall be affixed in a suitable place in the building for the purpose of enabling combustion appliances to be safely installed."

Part IV of *The Post-War Building Studies No. 29 Fire Grading of Buildings* 1952 was concerned with flues, as discussed in BDM01-10.8, for Principle H. Principle I.1 addresses flues within compartmentation, as discussed in BDM01-10.9.

Gas services

Gas services may suffer from leaks, which present the additional hazard of Gas explosion when ignited, with risks to health and life safety, fire spread, and damage to fire resisting compartmentation. In extreme cases, accumulated Gas leaks, if ignited, may threaten the structural stability of the building, addressed as Principle H. Gas services require quality of work, discussed as Principle U.

Gas Mains, service supply pipes, and Meters should not be located within a protected stairway as Paragraph 3.80 in Volume 1 and Paragraph 3.39 in Volume 2 of BDM01-16 (E-AD-Bv2). The protected stairway should not contain gas services.

Gas regulations

Gas service installations to the Pipelines Safety Regulations 1996 and the Gas Safety (Installation and Use) Regulations 1998 should be in a dedicated locked and ventilated service riser compartment, separate from any compartments that provide escape routes horizontally or vertically.

https://www.legislation.gov.uk/uksi/1996/825/contents/made

https://www.legislation.gov.uk/uksi/1998/2451/contents/made

In new buildings, Gas compartmentation can be achieved by design. In existing buildings where Gas is being considered for the first time, the compartmentation approach should be a condition of the refurbishment plans. Loss of floor area or greater cost should not be a justification for ignoring separation and ventilation of gas supplies.

Integrated services

Several building services to be integrated with the detection and alarm system as Principle R shall be discussed in their specification and location with the Fire and Rescue Service as Principle F. They include but may not be limited to:

- Sprinklers
- Emergency power supplies
- Fire control panels, possibly in dedicated rooms
- Automated closing devices for fire resisting windows, doors or vents
- Electromagnetic hold-open devices for fire doors
- Fire curtains
- Fire shutters
- Heating, Ventilation and Air Conditioning (HVAC)
- Natural opening smoke ventilation of escape stairs and corridors
- Mechanical Pressurisation of escape stairs and lobbies
- Natural Smoke and Heat Exhaust Ventilation (N-SHEV)
- Mechanical Smoke and Heat Exhaust Ventilation (M-SHEV)
- Emergency lighting and illuminated fire signage

AOVs

The two natural smoke control systems may include an Automated Opening Vent (AOV) arrangement in the external envelope. The AOVs must be integrated into the architectural fenestration as Principles K and L.

Maintenance

The maintenance commitments for building service installations of all kinds are to be kept as Principle Y. Long term commitments to maintenance are made by the consultants designing the installation, and these can be onerous if not considered and agreed with the client during the design phase.

Suspension fixings

The Construction Fixings Association (CFA) represents the major manufacturers of fixing systems which are set in drilled holes, discussed further in BDM01-10.17.

https://www.the-cfa.co.uk/

Soft Landing

Soft Landing as Principle V requires a building delivery approach that runs through the project Work Stages. Effort is made to avoid delay at Work Stage 6. The Building Services Research and Information Association (BSRIA) Soft Landings Network was established in 2010 to support understanding of this process, promote its uptake across the industry, and ensure its continuous development.

https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/user-group/

https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/guides/

Hard Landing

A "hard landing" at development handover is to be avoided. It is too late to discover an unexpected lack of resilience or unresolved hazards to health and life safety in design and construction when the "Responsible Person" is appointed by the building owner or operator under the Regulatory Reform (Fire Safety) Order 2005 at handover.

https://www.legislation.gov.uk/uksi/2005/1541/contents

Battery storage

Electricity sub-stations require 240 Minute fire resistant compartments but a lithium-ion battery energy store presents different risks of a runaway chemical reaction fire compared with a grid utility. RISCAuthority "Need to Know Guides" are available, with an emerging terminology at this frontier of knowledge:

- RE1 *Battery energy storage systems: commercial lithium-ion battery installations* Version 1 – December 2022
  https://www.thefpa.co.uk/resource-download/626
- RE2 *Lithium-ion Battery Use and Storage* Version 1 – January 2023
  https://www.thefpa.co.uk/resource-download/629

The developing RE series of "Need to Know Guides" may provide a distillation of information that supersedes some guidance in the Risk Control (RC) series, which facilities managers may consider as Principle W, discussed in BDM01-10.23.

Hydrogen services

As hydrogen is increasingly used as an energy storage medium, piped into buildings as a gas supply, and used for reverse electrolysis in fuel cells, there may be additional risks for facilities managers to consider as Principle W, to be considered early as Principle F.9.

Requirement J6

BDM01-11.9 Part J Combustion appliances and fuel storage systems in Schedule 1 Requirements of the Building Regulations 2010, as amended, contains Requirement J6 for the protection of liquid fuel storage systems, which says:

"Liquid fuel storage systems and the pipes connecting them to combustion appliances shall be so constructed and separated from buildings and the boundary of the premises as to reduce to a reasonable level the risk of the fuel igniting in the event of fire in adjacent buildings or premises."

Storage facilities

This is given practical meaning in *Approved Document J: Combustion appliances and fuel storage systems* (2010 as amended 2010, 2013 and 2022), as BDM01-16 (E-AD-J). As fuel storage of gases or energy storage, using chemical battery or "heat store" technologies, become widely distributed, their design and installation requires consideration in the Resilience Strategy, as Principle A. The Fire and Rescue Service should be consulted as Principle C on how they will intervene in a fire within, or spreading to involve, a fuel, energy or heat storage facility. The prospect of arson is addressed as Principle E.4.

10.7 Principle G – Address Occupational Issues

Principle G – Address Occupational Issues

Address the design, construction, management, and rearrangement of the building to specific hazards and risks facing occupants as "Relevant Persons", occupying either a building in an identified purpose group or a mixed-use facility.

G.1 Evacuation and Fire Strategies consider occupants as "Relevant Persons"

G.2 Resilience Strategy further considers occupants as "Relevant Persons"

G.3 Purpose Groups in core document BDM02 are considered for the occupancy

G.4 Combustible contents as occupational fire load in the Resilience Strategy

G.5 Material change of use shall be considered in consultation with insurers

G.6 Building owners or operators periodically meet with insurers as Principle Z

"Relevant Persons"

In this document, reference in Principle G to "Relevant Persons" has a wider definition than that in Section 4(3) of the Building Safety Act 2022 concerned with relevant persons in or about "higher-risk buildings", discussed as BDM01-14.

https://www.legislation.gov.uk/ukpga/2022/30/contents

The definition of "higher-risk buildings" in Part 4 of the Building Safety Act 2022 is explicitly intended to be amended over time, expanding or contracting to define the role of the Building Safety Regulator (BSR). That is a narrow definition.

https://www.legislation.gov.uk/ukpga/2022/30/part/4

Other legislation may similarly impose limited meanings to the legal use of the phrase "Relevant Persons", but that is not the meaning of Principle G.

All buildings present specific hazards and risks to occupants as "Relevant Persons".

Whether the building under consideration is in an identified Purpose Group or is a mixed-use facility, the "Relevant Persons" in Principle G shall be identified, so far as reasonably practicable, in the Resilience Strategy developed as Principle A. That strategic development is achieved through consultation with insurers as Principle B and the Fire and Rescue Service as Principle C, and could involve the "Relevant Persons" as natural persons, where known at the time. Improved identification and involvement of "Relevant Persons" is discussed as Principle Z.

Purpose Groups

Purpose Groups provide structure to BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022, in seven BDM02 Tables as Principle G.3, in book and poster form:

- BDM02 Table 1 Residential Dwellings
- BDM02 Table 2 Residential other than Dwellings
- BDM02 Table 3 Office
- BDM02 Table 4 Shop, Commercial and Large Retail
- BDM02 Table 5 Assembly and Recreation
- BDM02 Table 6 Industrial
- BDM02 Table 7 Storage and Car Parking

https://www.thefpa.co.uk/resource-download/405

https://www.thefpa.co.uk/resource-download/235

Statutory guidance

This document refers only to Table 0.1 Classification of Purpose Groups in the English statutory guidance of both Volumes of BDM01-16 (E-AD-B). The objective of relating English Purpose Groups to the differentiated Scottish, Welsh, and Northern Irish treatment of compartmentation and sprinklers will follow in a subsequent Revision of BDM02, discussed as BDM01-5.

Volume 1 Dwellings of (E-AD-B) includes Flats. The statutory guidance of Volume 2 Buildings other than dwellings of (E-AD-B) also refers to:

- Health care premises
- Unsupervised group homes
- Shopping complexes
- Assembly buildings
- Schools
- Prisons
- Buildings of special architectural or historic interest

Principle G.5

Any material change of use shall be considered in consultation with insurers as Principle B, approved by the local planning authority where not a permitted development right, and notified to the building control inspector as Regulation 5 of the Building Regulations 2010.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/5

Education Act 1996

The Education Act 1996 places a duty on the Secretary of State to prescribe standards for the premises of all maintained schools in England and Wales.

https://www.legislation.gov.uk/ukpga/1996/56/contents

Formerly the Department for Children, Schools and Families (DCSF), the Department for Education (DfE) provides a collection of guidance documents and tools that augment the statutory guidance to help with the design and construction of school and further education college buildings and grounds.

https://www.gov.uk/government/collections/school-design-and-construction

Schools

DfE *Advice on standards for school premises: For local authorities, proprietors, school leaders, school staff and governing bodies* – March 2015 provides further background but is increasingly out of date.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/410294/Advice_on_standards_for_school_premises.pdf

DfE *Building Bulletin 100: Design for fire safety in schools* (BB100) was published in 2007 and is being revised following discoveries by the Grenfell Tower Inquiry.

https://www.gov.uk/government/publications/building-bulletin-100-design-for-fire-safety-in-schools

Class 0 deprecated

On page 120, BB100 defines Class 0 consistently with BDM01-16 (E-AD-Bv2)(2006 as amended 2010 and 2013), as discussed in BDM01-10.4:

"The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

a. composed throughout of materials of limited combustibility; or

b. a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6.

Note: Class 0 is not a classification identified in any British Standard test."

Sprinklers in Schools

Government provides advice on assessing the financial and social risk of school fires in BB100, which is supported with a *Risk assessment tool for sprinklers in school* and a *Cost benefit analysis tool*. This should be revised with BB100.

www.gov.uk/government/publications/building-bulletin-100-design-for-fire-safety-in-schools

School fires

In November 2007, the National Foundation for Educational Research (NFER) published research by Pauline Wade, David Teeman, Sarah Golden, Rebekah Wilson, and Vanessa Woodley as *The impact of school fires: A study of the wider economic and social impacts on schools and the local community*. This report was produced as part of the Local Government Education and Children's Services Research Programme.

https://www.nfer.ac.uk/publications/lfw01/lfw01.pdf

Call for sprinklers

As the Grenfell Tower Inquiry opened, London Fire Commissioner Dany Cotton called for sprinklers in high-rise residential buildings and schools. She was forced to resign by December 2019 as a result of criticism of the LFB.

https://www.london-fire.gov.uk/news/2017-news/fire-chief-urges-action-on-sprinklers-as-grenfell-inquiry-opens/

11m trigger height

By the 2020 amendment of (E-AD-Bv1)(2019), the "trigger height" for sprinklers in Flats was reduced from 30m to 11m by DLUHC. This is reflected in BDM02 Table 1 Residential Dwellings. No further change is expected from DLUHC by the 2022 amendment of either Volume of (E-AD-B)(2019 as amended 2020).

BB100 review

The DfE appears determined to resist mandating sprinklers for schools in BB100.

Following public consultation from 8 March to 31 May 2019, the DfE published *Technical Review of Building Bulletin 100: Design for Fire Safety in Schools – Call for Evidence Report* – June 2021.

In this report, the government claimed respondents had suggested that sprinklers meant "... less need for passive measures, that there could be greater use of glazing, and that it would be safer to use cheap, environmentally friendly materials such as wood".

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/993062/BB100_call_for_evidence_response.pdf

From 27 May to 18 August 2021, government publicly consulted further on BB100, establishing a dedicated DfE website.

https://consult.education.gov.uk/technical-standards/building-bulletin-100/

https://www.gov.uk/government/consultations/building-bulletin-100-fire-safety-design-for-schools

Campaigning

In an open letter to the then Education Secretary Gavin Williamson on 17 August 2021, a coalition brought together by insurer Zurich Municipal, including the FPA, demanded government rethink the decision not to make sprinklers compulsory in all new build and majorly refurbished schools, regardless of their height.

https://www.zurich.co.uk/media-centre/industry-bodies-unite-to-condemn-dfe-school-fire-safety-proposals

In an article of 8 March 2021, Zurich had reported "More than 1,100 classrooms gutted by school blazes".

https://www.zurich.co.uk/en/about-us/media-centre/general-insurance-news/2021/more-than-1100-classrooms-gutted-by-school-blazes

ABI campaign

The Association of British Insurers (ABI) has long argued for sprinkler protection in educational facilities. In 2016, the ABI made their position clear, arguing that all new and existing school buildings should be sprinklered to the LPC Sprinkler Rules, regardless of height, and with improvements to compartmentation.

https://www.abi.org.uk/globalassets/files/subject/public/home-insurance/abiresponse-department-for-education-consultation-on-fire-safety-design-for-schools.pdf

Schools are primarily Purpose Group 5 in BDM02 Table 5 Assembly and Recreation buildings. However, they may include Purpose Group 3 Offices, or be boarding schools with buildings in the grounds that are Purpose Group 2(a) Residential (Institutional) as BDM02 Table 2 Residential other than Dwellings. Sprinklers in schools are recommended as Principle I.

Healthcare

The Department of Health and Social Care (DHSC) relies on NHS England to publish a complete list of publications related to NHS estates.

https://www.england.nhs.uk/publication/complete-list-of-nhs-estates-related-guidance/

Last updated on 22 December 2021, this includes but is not limited to series of:

- Health Building Notes (HBN)
  https://www.england.nhs.uk/estates/health-building-notes/
- Health Technical Memoranda (HTM)
  https://www.england.nhs.uk/estates/health-technical-memoranda/

There are many HBNs and HTMs as a resource, with three related to fire safety.

NHS HTM 05-01

(HTM 05-01) *Managing Healthcare Fire Safety* – 2013 Edition anticipates the concerns in Principle W. It is essential reading for the client's "Lead Designer".

https://www.england.nhs.uk/publication/managing-healthcare-fire-safety-htm-05-01/

NHS HTM 05-02

HTM 05-02 *Firecode: Guidance in support of functional provisions (Fire safety in the design of healthcare premises)* – 2015 Edition.

https://www.england.nhs.uk/publication/fire-safety-in-the-design-of-healthcare-premises-htm-05-02/

https://www.england.nhs.uk/wp-content/uploads/2021/05/HTM_05-02_2015.pdf

Class 0 deprecated

On page 67 of HTM 05-02 (2015), the NHS defines Class 0 using clearer language than BDM01-16 (E-AD-Bv2) (2006 as amended 2010 and 2013), discussed as BDM01-10.4:

"**Class 0 surface spread of flame:** the classification achieved by a material or composite product which is either:

a. composed throughout of materials of limited combustibility; or

b. a Class 1 material (when tested in accordance with BS 476-7:1971 or 1987) which, when tested in accordance with BS 476-6:1981 or 1989, has a fire propagation index (I) of not more than 12 and a sub-index (i1) of not more than 6.

Class 0 is not a classification identified in any British Standard test."

Life safety limitation

Clause 5.68 in HTM 05-02 2015 says:

"With the exception of buildings over 30 m in height, the guidance in this document does not require the installation of sprinklers in patient care areas of healthcare buildings. However, the design team is expected to consider the advantages that may be gained by installing life-safety sprinklers throughout the building or to specific areas."

Principle A goes beyond the health and life safety limitation in legislation and statutory guidance, discussed as BDM01-5. HTM 05-02 2015 does not argue for resilience in asset or property protection in healthcare buildings. Were it to do so there would be a stronger argument for sprinklers, as Principle I.

Healthcare buildings where people sleep on the premises are Residential (Institutional) as Purpose Group 2(a) in BDM02 Table 2 Residential other than Dwellings. Sprinklers to one of the two options in the LPC Sprinkler Rules allow the maximum compartment size to double to 1000 m2. For Purpose Group 3 Offices or Purpose Group 5 Assembly and Recreation buildings, which may also be present in a healthcare campus or Mixed Use building, there are other advantages from the installation of sprinklers to the LPC Sprinkler Rules.

NHS HTM 05-03

HTM 05-03 *Fire safety in the NHS: Operational provision* has a number of Parts that have been updated in various Editions over time:

Part A General fire safety

Part B Fire detection and alarm systems

Part C Textiles and furnishings

Part D Commercial enterprises on hospital premises

Part E Escape lifts in healthcare premises

Part F Arson prevention in NHS premises

Part G Laboratories on healthcare premises

Part H Reducing false alarms in hospital premises

Part J Guidance on fire engineering of healthcare premises

Part K Guidance on fire risk assessments in complex healthcare premises

Part M Fire Safety in Atria

https://www.england.nhs.uk/publication/fire-safety-in-the-nhs-health-technical-memorandum-05-03/

Sector guidance

RISCAuthority Sector Guidance is available in the BDM series as follows:

- BDM03 *Fire protection of buildings – Warehouses and storage buildings 1: Design principles* https://www.thefpa.co.uk/resource-download/236
- BDM04 *Fire protections of buildings – Stand-alone cold stores 1: Design principles* https://www.thefpa.co.uk/resource-download/237
- BDM05 *Fire protection of buildings – Food processing factories 1: Design principles* https://www.thefpa.co.uk/resource-download/238
- BDM09 *Fire risk minimisation guidance for the food industry* https://www.thefpa.co.uk/resource-download/241

A review of this sector guidance, and a suite of BDM titles that better relate to the Purpose Groups in BDM02, is being considered. This might coincide with the proposal for Regulation 38 Templates as Principle V. The Purpose Groups are broad and will require a logical sub-division, giving greater focus on occupancy.

Participation

The underlying issue in residential Purpose Groups 1 and 2, if not in others, is one of who makes the decision about what constitutes a safe Evacuation Strategy within a safe Fire Strategy. Sociologists have asked such questions before. For example, in 1969 Sherry Arnstein conceptualised *A Ladder Of Citizen Participation*:

"The heated controversy over 'citizen participation', 'citizen control', and 'maximum feasible involvement of the poor', has been waged largely in terms of exacerbated rhetoric and misleading euphemisms."

https://www.tandfonline.com/doi/abs/10.1080/01944366908977225

Trust

All occupants as "Relevant Persons", but in particular residents of Flats, are being asked to trust the "Responsible Person" appointed by the building owner or operator, who may or may not have a facilities manager. Or they are asked to trust the client, consultants, and contractors who precede the "Responsible Person". These several professionals need sensible answers to questions about the Evacuation Strategy, along with excellent communication skills, in order to hold meaningful conversations with "Relevant Persons" as natural individuals, with personal capacities, concerns, and expectations.

Behaviour in fire

Understanding human behaviour in fire, or "behavior in fire" as the American spelling, is an established field of research that must be reconciled with a sociological view of building users as subjective agents in both non-fire and fire situations. This goes beyond the Evacuation Strategy.

Home Office 1992

Escape was the concern of the Fire and Emergency Planning Department of the Home Office with the publication of research by Jonathan Sime, Chris Creed, Michiharu Kimura and James Powell, Research Report No.45 – *Human Behaviour in Fires Summary Report* – 1992. This work was the result of a three-year research project on escape behaviour in fires between 1985 and 1988, and argued:

"Serious attention should be directed to the apparent assumption that time to escape is exclusively dependent on time to travel to and through exits. It is felt that 'escape time' should take into account 'reaction to alarm time' and the two phases of 'time to start' and 'time to move' should be explicitly addressed in design codes of practice and regulatory literature."

https://www.ukfrs.com/sites/default/files/2017-09/Human%20Behaviour%20in%20Fires%20-%20Summary%20Report.pdf

Academic research

Among other academics Jonathan Sime had researched human behaviour in fire before that publication. There is a body of academic research referred to by Erica Kuligowski in the National Institute of Standards and Technology (NIST) Technical Note 1632 *The Process of Human Behavior in Fires*, published in 2009.

https://www.nist.gov/publications/process-human-behavior-fires-0

SFPE guide

The Society of Fire Protection Engineers (SFPE) *Guide to Human Behavior in Fire* – Second Edition, published in 2018, may be considered a standard reference. It is concerned with:

- Incapacitating effects of fire effluent
- Toxicity analysis methods

- Occupant behavior scenarios
- Movement and behavioral models
- Egress model selection, verification, and validation
- Estimation of uncertainty and use of safety factors
- Enhancing human response to emergencies notification of messaging https://www.sfpe.org/publications/guides/humanbehavior

Yet, as discussed in BDM01-10.3, the toxicity of smoke is not addressed in Schedule 1 Requirements of the Buildings Regulations 2010, and consequently the statutory guidance as BDM01-16 (E-AD-D) does not consider smoke as a toxic substance.

Resilience

The Evacuation Strategy and Fire Strategy as Principle C, which are all part of the Resilience Strategy as Principle A need to be developed to provide insight on occupational issues ranging from individual behaviour to changing sociological factors. These issues are reviewed as Principle Z.

10.8 Principle H – Extend Structural Stability

Principle H – Extend Structural Stability

Engineer against structural collapse and excessive deflection within compartment walls and floors, to accommodate all imposed loads in fire situations, beyond the statutory life safety requirement and risk of accidental disproportionate collapse.

H.1 Prevent partial structural collapse for an extended period of time

H.2 Accommodate all imposed loads in the expected non-fire and fire situations

H.3 Consider the building as an entity and in the structure of compartments

H.4 Prevent collapse of the primary roof structure in the protected zone

H.5 Minimise movements by limiting deflections in expected non-fire situations

H.6 Define tolerances through iterations of a Movements and Tolerances Report

H.7 Remove the risk of accidental disproportionate collapse of primary structure

H.8 Protect from consequential damage, facilitate simple repair and plan salvage

H.9 Specify any maintenance required by the primary structure as Principle Y

BS EN 13501-2

The structural fire resistance Stability (R) should be classified to the European BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*, as Principle H.1, avoiding the National BS 476 series. Any combustible external wall construction discussed in Principle D should not adversely affect the Stability (R) of a fire resisting primary structure. However, Principle I identifies the protected zone where the external wall construction may also need to be fire resisting, with separation of external openings addressed in Principle K.

BS EN 13501-5

BS EN 13501-5:2016 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests* is not about structural Stability (R). For Principle H.4, the primary roof structure requires fire resistance that should be addressed through BS EN 13501-2. Principle I.5 identifies where the roof construction should also be fire resisting. BS EN 13501-5 is later referred to in Principle L.2 about fire ingress from neighbouring buildings.

Post-war fire grading

The Joint Committee of the Building Research Board of the Department of Scientific and Industrial Research (DSIR) and of the Fire Offices' Committee (FOC) had established a typological grading for building structures in Ministry of Works (MoW) *Post-War Building Studies No. 20 Fire Grading of Buildings*, 1946:

Part I General Principles and Structural Precautions

Type 1 **Fully Protected Structure for Occupancies of High Fire Load**
240 Minutes Structural Stability

Type 2 **Fully Protected Structure for Occupancies of Medium Fire Load**
120 Minutes Structural Stability

Type 3 **Fully Protected Structure for Occupancies of Low Fire Load**
60 Minutes Structural Stability

Type 4 **Partially Protected Structure**
Minimum 30 Minutes Structural Stability with additional Fire Protection

Type 5 **Externally Protected Structure**
Non-Combustible External Walls with 120 Minutes Structural Stability

Type 6 **Unprotected Non-Combustible Structure**
Non-Combustible construction with no Structural Stability

Type 7 **Unprotected Combustible Structure**
Combustible construction with no Structural Stability

The *Post-War Building Studies No. 29 Fire Grading of Buildings* 1952 addressed:

Part II Fire Fighting Equipment

Part III Personal Safety

Part IV Chimneys and Flues

The way that chimneys and flues are addressed in Schedule 1 Requirements of the Building Regulations 2010, as amended, is further discussed as BDM01-10.6, in relation to Principle F. Principle I.1 addresses flues within compartmentation.

Burn-out of contents

As explained in Paragraph 47 of *Fire Grading of Buildings* – Part I 1946:

"We have taken, as a starting-point for grading, a form of construction so protected that the structural elements will resist a complete burn-out of the combustible contents without failure, and restrict spread of fire out of the compartment in which it starts, irrespective of any other means of dealing with the fire. We then consider other forms of construction giving lower levels of structural protection. It would be unduly onerous to require that every building should be so protected that it would resist a complete burn-out of its contents without collapse."

As explained in Paragraph 59:

Non-combustible

"Although a relatively high standard of fire resistance may be obtained with certain combustible elements of structure by taking special precautions, their incorporation in buildings of Types 1–3 construction would defeat the object aimed at in those types. For example, a timber joist floor may be protected by means of pugging and special ceilings so that it affords 1 hour or more fire resistance under test conditions, but fire on the upper surface may ignite the structure and lead to a complete burn-out. We therefore consider that all structural parts of buildings of Types 1–3 construction which are required to have a specified grade of fire resistance should be of incombustible material, except that timber doors which attain the required grade may be used."

Guidance in Paragraph 140 is particularly striking, with Cross Laminated Timber (CLT) promoted as MMC, or Type 7 Unprotected Combustible Structure:

Timber structure

"The use of treated timber may, however, prevent a fire developing or at least reduce its severity in buildings where the woodwork contributes the main source of fuel. It must be noted, however, that impregnation may not penetrate more than a short distance from the surface of a member, and the timber in the core will burn if conditions are sufficiently severe to cause the impregnated layer to char and fall away. The use of built-up members, the laminae of which are impregnated before fabrication, would, however, largely remove this difficulty."

Fire resistance

The intellectual debt owed by the *Fire Grading of Buildings* – Part I 1946 to pioneers such as architect Edwin Otho Sachs is neatly articulated by Angus Law and Luke Bisby in "The rise and rise of fire resistance", *Fire Safety Journal*, Volume 116, September 2020.

https://doi.org/10.1016/j.firesaf.2020.103188

E. O. Sachs was the founder of the British Fire Prevention Committee (BFPC) and the Institution of Structural Engineers (IStructE), through his magazine *Concrete and Constructional Engineering*. Angus Law and Luke Bisby note:

"The Fire Grading Committee observed that in selecting the period of fire resistance required to resist burnout for a particular occupancy, it was necessary to make a decision about how much fuel was likely to be present in that occupancy. They settled on three grades, these being low, moderate, and high fuel loads. Occupancies were grouped into these three categories based on survey results from real buildings."

UK guidance claim

However, Angus Law and Luke Bisby also unconvincingly claim that burn-out is implied in the "UK guidance". They appear to argue that when more than 30 minute fire resistance for compartmentation is identified in statutory guidance for England, Scotland, Wales and Northern Ireland, the implication is that the compartment shall hold and full structural protection shall be provided.

"In the UK, where statutory guidance recommends 30 min as a period of fire resistance, it appears to be implicit that these buildings are not generally expected to resist burnout. Where statutory guidance recommends more than 30 min fire resistance (for offices or residential buildings), it is implicit that burnout resistance is 'expected'."

Which in the abstract to their paper becomes the more assertive claim:

"It is shown that within UK guidance, where statutory guidance recommends 30 min as a period of fire resistance, such buildings are not expected to resist burnout. Where guidance recommends more than 30 min fire resistance (for offices or residential buildings), it is intended that such buildings should resist burnout."

Were this true, which it is not, the statutory guidance across all four devolved administrations would be expecting or intending property protection. However none do so, because the objective is "life safety before collapse", or a legal commitment to health and life safety. Regrettably, in non-mandatory UK statutory guidance, collapse is not expected or intended to be prevented by a commitment to fire resistance periods that provide burn-out as described in the *Fire Grading of Buildings* – Part I 1946.

Unfortunately, at no time since the first Building Regulations were made law in 1964 and 1965, when the *Fire Grading of Buildings* – Part I 1946 were replaced by legislation, has burn-out been a legal requirement.

In England there is no burn-out requirement in Schedule 1 of the Building Regulations 2010. In the English statutory guidance of Approved Documents, that follow Schedule 1 and the other Building Regulations, there is no implication to be read as an expectation or intention that burn-out shall define compartment fire resistance above a 30 minute threshold. Hence the need for BDM02.

Occupancy fuel load

In a future revision of BDM01, there may be benefit in using a similar grading approach to assess the seven Purpose Group Tables in BDM02 in relation to the LPC Sprinkler Rules, which may be contrasted to the fire resistance Tables in statutory guidance. The essential point will be to identify compartmentation that will "... burn-out of its contents without collapse".

Resilience

For resilience as Principle A, the property loss needs to be limited through passive compartmentation and sprinkler activation, allowing ample time for the Evacuation Strategy and for Fire and Rescue Service intervention to extinguish the fire after the contents have burned out. Any combustible structure should not be on fire after the period required for burn-out, with no smouldering combustion confirmed.

Firefighting

A developing fire may be "ventilation-controlled", presenting the risk of rapid and forceful development on sudden ventilation. Alternatively, a developing fire may be "fuel-controlled", where there is sufficient ventilation at all phases.

Fire development shall be fully considered in consultation with the Fire and Rescue Service as Principle C. It is important to consider when windows, doors, and vents are left open for fresh air ventilation in the non-fire situation, and when non-fire resisting glass shatters in the heat of a fire situation. The effect of adverse wind conditions is addressed as Principle M.

Gas leaks

Gas utilities may suffer from leaks, which if allowed to go undetected within unventilated accommodation, shafts or cavities, may ignite to explode, causing disproportionate collapse of the building structure. The case of Ronan Point is mentioned in connection with Principle D, but the monitoring of building services as Principle F, quality of work as Principle U, and their maintenance as Principle Y are also important.

The potential risk of gas explosion shall be designed out to satisfy Requirement A3 in Schedule 1 of the Building Regulations 2010, as BDM01-11. Lesser gas leaks present the hazard of a smaller gas explosion if ignited, with localised damage to compartmentation, including the external wall and roof, if not primary structure.

Vehicle impacts

Vehicle impact may cause disproportionate collapse of the building structure. This potential risk shall also be designed out to satisfy Requirement A3 in Schedule 1 of the Building Regulations 2010, as BDM01-11.

Expected situations

Loadbearing primary structures shall be considered for the risk of disproportionate collapse under Requirement A3, but this is for accidental damage, such as by vehicle impact or gas explosion. Loadbearing primary structures shall additionally be structurally engineered to accommodate all imposed loads as Requirement A1 in Schedule 1 of the Building Regulations 2010, as BDM01-11, in both the expected non-fire and fire situations. Fire situations are to be expected.

Principle A.6

Principle A.6 is concerned with the coherence of thinking in the project documents, which should include the Movements and Tolerances Report. A weak or vague Movements and Tolerances Report may reveal a lack of coherence in the strategic thinking about health and life safety under the law, and additional resilience. The lack of a disciplined programme for Strategy, Testing, Inspection, Certification, and Compliance (STICC) as Principle S may affect the structural engineer.

Natural person

Where they are not a structural engineer, the client or their appointed natural person may need to rely on another structural engineer to review the project Movements and Tolerances Report, independent of the project structural engineer, to achieve Principle A.6. Such independent checking is not unusual for structural engineers, but the wider task is to understand how the structure satisfies the Resilience Strategy. This is in addition to the legal requirement for health and life safety in the Evacuation Strategy within the Fire Strategy.

Structural Engineer

The Institution of Structural Engineers (IstructE) recognises the importance of preparing a shared Movements and Tolerances Report which both qualifies and quantifies the anticipated movements during the lifetime of the building, the tolerances to be achieved during construction, and the design solutions to accommodate these movements and tolerances. The document production must be led by the Structural Engineer, though they may not be the "Lead Designer".

https://www.istructe.org/IStructE/media/Public/Resources/Guidance-to-structural-plan-of-work-20200701.pdf

Design development

Shared understanding of how the structure relates to the architectural form and fenestration, manifesting in construction detailing, develops through design Work Stages. This continues in the construction Work Stages, where further design development is undertaken by the contractor. The Movements and Tolerances Report must be communicated to and comprehended by sub-contractors and their consultants.

It is important that the Movements and Tolerances Report for the project considers both the expected non-fire situations and the expected fire situations. This is not a trivial technical task and requires a clarity of thought by the structural engineer to communicate practical meaning to specialists from other professions.

Fees for M&T Report

Very often, an inadequate fee is allocated to all those variously involved in the production of iterations of the Movements and Tolerances Report over a protracted project programme. This is a false economy, creating unintended consequences that can become significant and costly patent or latent defects.

A project specific Movements and Tolerances Report for non-fire and fire situations shall be within the Employer's Requirements for tendering to contractors. That may not be the final iteration, but it should be an advanced draft. The final iteration is to be checked against the Regulation 38 Fire Safety Information exchange the client receives as Principle V.

The ability of the structural engineer to achieve Principle H logically depends upon operational advice from the Fire and Rescue Service, obtained by undertaking early consultation as Principle C. Some structural engineering consultancies have developed a fire engineering specialism, perhaps alongside a façade engineering specialism. The fire engineers may be members of the Institution of Fire Engineers (IFE).

Communication

Such a multi-disciplinary approach only has advantages if the engineering specialists are adept at communication with each other between departments, and with the array of consultants and contractors on the client's project.

There may be knowledge gaps between specialists that a client may anticipate or be fortunate to identify in design phase Work Stages, rather than post-contract.

For example, there may be unfamiliarity with the roof among façade engineers who have concentrated on the external wall. Some façade engineers will be able to consider the building envelope as a whole, with roofing sometimes considered as the "fifth façade". Sometimes external walls merge into roofs in the architecture.

SFE joint initiative

The Society of Façade Engineering (SFE) was formed in 2004 as a joint initiative of CIBSE, IStructE, and the RIBA. It is governed by a Council drawn from among its members and administered by CIBSE. This is a measure of the importance of questions relating to daylighting, thermal insulation, or fresh air ventilation to the design of the external wall, if not the whole building envelope, as they relate to building services engineering. The specialisation of façade engineers is considered further in BDM01-13 when discussing adverse weather.

https://www.cibse.org/get-involved/societies/society-of-facade-engineering-sfe/about-facades

Maintenance

Despite the joint initiative of SFE, the Maintenance Strategy is often delegated as a separate specialism for "façade access". At worst, and too often, maintenance as Principle Y is considered a project afterthought when it should be a strategic factor during compilation of the contract documents including the Health and Safety File by the "Principal Designer". The "Lead Designer" should have access in mind.

Principle B.9 is the prior consideration, when the necessity for working at height is either designed out or risk managed so far as reasonably practicable, particularly when considering roofs and external walls with their geometry of recesses and projections. The "Lead Designer", architect, or any façade engineer may be designing in a maintenance commitment that passes a burden to the building owner or operator and their facilities manager.

SAEMA trade body

The Specialist Access Engineering and Maintenance Association (SAEMA) is the national trade body for the permanent and temporary façade access equipment industry. The structural engineering shall accommodate the moving loads, with their related but often disregarded acoustic challenges, posed by a travelling Building Maintenance Unit (BMU). Discussed as Principle Y but to be anticipated in Principle H with SAEMA members providing specialist advice.

https://www.saema.org/guidance/

Poor project management by or on behalf of the client may allow the structural engineer to have disregarded large BMU loads on a pared down structure that no acoustician may engineer against impact sound transmission, with connections that are difficult to weather and thermally insulate while needing inspection.

Installation of a BMU is not to be confused with construction phase questions of access that concern the "Principal Contractor". An installed BMU is not to be abused for construction works and will require an insurance inspection by handover. Maintenance equipment needs to be inspected, maintained in service, and eventually replaced.

Multi-discipline test

The multi-disciplinary specialisation within engineering consultancies is sometimes a sign of the diminution of technical expertise in the architectural profession, even though the architect may be the "Lead Designer". Claims by engineering consultancies offering competitive structural/fire/façade/services/access consultancy packages should be tested for their coherence by the appointing client, focused on the Movements and Tolerances Report as it relates to the Resilience Strategy.

Inter-discipline test

A client's "Lead Designer", whether or not they are the "Principal Designer", needs to be able to interrogate and respond to a Movements and Tolerances Report that explains the non-fire and fire situations to professionals who are not trained as structural engineers. Lack of explanation of how Stability is extended in the fire situation may disguise a disconnect in the structural/fire engineering. Principle H is an important test of inter-disciplinary collaboration, with Principle I in mind.

10.9 Principle I – Reduce Fire Severity

Principle I – Reduce Fire Severity

Compartmentalise and fully protect the building with a sprinkler system so that if a fire starts, the extent of fire, heat, and smoke damage should be minimised and confined in the compartment of origin, so far as reasonably practicable.

I.1 Compartmentation with enhanced fire resisting construction as BDM02

I.2 Sprinkler protected to the LPC Sprinkler Rules 2015 and Technical Bulletins

I.3 Alternative suppression agreed with insurers and Fire and Rescue Service

I.4 Enhancements to Stability (R) for the primary structure as Principle H.1

I.5 Protected zones aligned in roofs and external walls, supported by structure

I.6 Fire resistance of protected and unprotected zones in roofs with openings

I.7 Dimension protected zones in roofs with allowances for projections

I.8 Openings in the roof not located within protected zones unless fire resisting

I.9 Roof mounted plant and building services supported in the roof zones

I.10 Interfaces with fire stopping between roofs and internal compartment walls

I.11 Alignment of cavity barriers with internal compartment walls and openings

I.12 Inaccessible cavities within compartment walls and floors are risk managed

I.13 Protected zones in external walls considering cavity barriers or fire stopping

I.14 Penetrations through compartment walls and floors are fire stopped

I.15 Cavities from finishing construction internal to compartment accommodation

I.16 Smoke control systems consider cavities from finishing construction

I.17 Compartment walls and floors are Smoke Leakage (S) rated construction

I.18 Accessible openings through compartmentation to maintain fire resistance

I.19 Horizontal fire hatches and fire shutters (EIS) rated equal to floors

I.20 Vertical fire curtains, fire shutters, and fire doors (EIS) rated equal to walls

I.21 Fitting of self-closing devices on fire doors without exception

I.22 Glazing in compartment walls and floors of equivalent fire resistance

I.23 Access panels in compartment walls and floors of equivalent fire resistance

I.24 Building services access kept locked and checked by facilities managers

I.25 Roof spaces provide no horizontal distribution for building services

I.26 Fire resisting construction is tested, installed, checked, and maintained

Figure BDM01-10.9.1 BDM02 Version 2 – August 2022 – RISCAuthority

Core Document

Refer to BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022, in book and poster form:

https://www.thefpa.co.uk/resource-download/405

https://www.thefpa.co.uk/resource-download/235

LPC Sprinkler Rules

BDM02 Version 2 – 2022 is based on the LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 *Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance*, which provides the two Insurer supported options for augmenting sprinklers to BS EN 12845:2015+A1:2019 for property protection. The LPC Sprinkler Rules are updated with Technical Bulletins published by the RISCAuthority Sprinkler Working Group.

https://www.thefpa.co.uk/shop/lpc-sprinkler-rules-with-bsen12845-book

Purpose Groups

Compartmentation is considered in seven Purpose Groups:

BDM02 Table 1 Residential Dwellings

1(a) Residential (Dwellings) Flat with Car Parking as 7(b)

1(b) Residential (Dwellings) Dwellinghouse >4.5m above Ground

1(c) Residential (Dwellings) Dwellinghouse <4.5m above Ground

BDM02 Table 2 Residential other than Dwellings

2(a) Residential (Institutional)

2(b) Residential (Other)

BDM02 Table 3 Office

BDM02 Table 4 Shop, Commercial and Large Retail

4(a) Shop and Commercial other than 4(b)

4(b) Large Retail Warehouse or Superstore in which stock is on display

BDM02 Table 5 Assembly and Recreation

BDM02 Table 6 Industrial

6(a) Industrial Ordinary Hazard 1 to 2

6(b) Industrial Ordinary Hazard 3 to 4 and High Hazard Process

BDM02 Table 7 Storage and Car Parking

7(a) Storage categorised in Technical Bulletin TB217

7(b) Car Parking for light vehicles

Technical Bulletin TB217: 2018: Rev 1 – *Categorisation of goods in storage* is part of the RISCAuthority documentation available to members.

BS EN 13501-2

With BDM02 as the core document, Principle I recognises that compartmentation can be either loadbearing with fire resistance of (REI) or non-loadbearing with fire resistance of (EI). Stability (R), Integrity (E), and Insulation (I) should be classified to the European BS EN 13501-2:2016 *Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services*, avoiding the National BS 476 series.

BS EN 13501-5

BS EN 13501-5:2016 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests* is not about the fire resistance of either the primary roof structure as Principle H.4 or the roof construction as Principle I.5. Both require classification to BS EN 13501-2.

The passive fire protection of a compartment wall can be rendered ineffective as a consequence of an unprotected roof:

- distorting from or collapsing to expose the edge of the internal compartment wall; or
- being penetrated by a fire plume close to its interface with an internal compartment wall.

Roof protected zone

Both will allow direct flame or radiated heat to spread fire around the top edge of the internal compartment wall, involving the adjacent roof on the other side of the compartment line when combustible. A protected zone of non-combustible and fire resisting roof construction, fire stopped where necessary to the top edge of the internal compartment wall, should be provided to resist external fire spread.

The protected zone of the roof follows established thinking in BDM07 *Fire protection of buildings – Protected zone*, which may be updated to better align with BDM01, relating to the protected zone in the external wall as Principle K and its relationship to Principle L.

https://www.thefpa.co.uk/resource-download/240

Requirement B4(2)

Requirement B4(2) in Schedule 1 of the Building Regulations 2010, as BDM01-11, is addressed for health and life safety in BDM01-16 (E-AD-B) by testing and classification to BS EN 13501-5. This is a weakness in the statutory guidance because BS EN 13501-5 is about the prospect of a neighbouring building igniting the roof externally. It is not about an initially internal fire collapsing non-fire resisting roof structure or penetrating non-fire resisting roof construction, to ignite a combustible roof on the other side of the compartment wall line.

Layered construction

For roofs, BS EN 13501-5 is considered for fire ingress, as Principle L.2. However, the resilience in non-combustibility as BS EN 13501-1 is Principle D.1, with roofing built-up of layers of non-combustible and combustible materials.

Roof zone dimension

The dimension of the fire resisting roof protected zone as Principle I.5 should be agreed in consultation with the insurer as Principle B. The protected zone may not be the same dimension on both sides of the compartmentation. There may be advantages in varying dimensions to create an offset arrangement with an overall dimension. The protected zone may be varied according to locations of internal compartment walls, or to facilitate openings. Roof abutments to projecting compartments such as stair cores, lift over-runs, smoke vents or service risers also require consideration.

The protected zone is of architectural significance and will be iteratively revisited throughout the stages of the *RIBA Plan of Work 2020*, with the client referring back to insurers. Openings and projections should be resolved by submission of an application for Planning Approval, but minor amendments to the roof for aesthetic and technical reasons will continue to be made.

Wall protected zone

A similar provision of protected zones in the external wall is required as Principle K.

(REI) and (S)

After structural Stability (R) as Principle H, passive fire protection with Integrity (E) is also concerned with controlling the transfer of heat through Insulation (I) and preventing the passage of hot and cold smoke.

Principle I.17

Smoke ventilation shafts, as part of the smoke control systems that depend on fire resisting compartmentation, are tested to achieve a Smoke Leakage (S) rate as Principle F.2, discussed as BDM01-10.6.

Integration of building services as Principle F anticipates many of the issues of fire resistance in Principle I. This may be unsurprising to building services engineers, although they are unlikely to be the "Lead Designer" even in highly serviced buildings. Often, the design of non-loadbearing internal walls, through which many services will penetrate, is delegated to junior staff. Smoke requires "Principal Designers" and "Principal Contractors" to focus their personnel on the integration of compartmentation and building services.

Trade associations

The trade associations concerned with compartment construction are:

- Concrete Block Association (CBA)
  https://www.cba-blocks.org.uk/
- Finishes and Interiors Sector (FIS)
  https://www.thefis.org/
- Gypsum Products Development Association (GPDA)
  https://gpda.com/
- Light Steel Frame Association (LSFA)
  https://www.lsf-association.co.uk/

The shift from "wet trades" to "dry trades" in compartment construction has occurred at the same time as building services systems have become more sophisticated. This is rarely considered as an aspect of MMC, though it too has involved a shift from solid masonry to solid masonry to Light Steel Frame (LSF) with cavities in boarded construction as Principle J.

Accessibility

Fire stopping of building services that penetrate fire resisting compartmentation requires access through any non-fire resisting raised floors, wall linings, and suspended ceilings. Where not designed out, it is often preferable for raised floors, wall linings, and suspended ceilings to be demountable, rather than proliferating non-fire resisting access panels through the interior design. Design coordination at Work Stages 3 and 4 will improve access provision.

Access panels

The orderly concealment of building services in vertical shafts or horizontal voids constructed as fire resisting compartments requires fire resisting access panels as Principle I.23. Sometimes, these access panels are concealed in corridor wall finishes. At other times fire resisting doors in frames or doorsets to match accommodation doors are provided. Unlike fire resisting accommodation doors with self-closing devices, access panels for building service maintenance require only locks.

All sizes of access panel to compartments for building services, regardless of whether they are constructed as doors in frames or doorsets, should have a fire resistance equal to the construction they provide access through.

Fire stopping

The supporting notes BDM01-10.6 for Principle F referred to the collaborative *Firestopping of service penetrations – best practice in design and installation*.

https://www.thebesa.com/technical/publications-knowledge/fire-stopping-of-service-penetrations/

In addition to FIS and the GDPA, the other collaborating trade associations were:

- Association for Specialist Fire Protection (ASFP)
  https://asfp.org.uk/

- Building Engineering Services Association (BESA)
  https://www.thebesa.com/
- Building Services Research and Information Association (BSRIA)
  https://www.bsria.com/uk/

Quality of work

These trade associations are also working to improve compliance with Regulation 7(1), discussed as Principle T for materials quality and Principle U for competent work, to improve Regulation 38 Fire Safety Information exchange as Principle V.

BDM06 in future

The collaborative *Firestopping of service penetrations – best practice in design and installation* further suggests that BDM06 *Fire protection of buildings – Core Document – Protection of openings and service penetrations from fire* may be subsumed into BDM01 Essential Principles.

https://www.thefpa.co.uk/resource-download/239

Parts of the current BDM06 that explicitly address other advances in duct, pipe, and cable service installations as Principle F, with a discussion of penetrations through compartment walls and floors to be fire stopped as Principle I.14, may be brought into BDM01. A separately updated BDM06 would discuss the subject of internal compartment openings providing access as follows:

I.17 Compartment walls and floors are Smoke Leakage (S) rated construction

I.18 Accessible openings through compartmentation to maintain fire resistance

I.19 Horizontal fire hatches and fire shutters (EIS) rated equal to floors

I.20 Vertical fire curtains, fire shutters, and fire doors (EIS) rated equal to walls

I.21 Fitting of self-closing devices on fire doors without exception

I.22 Glazing in compartment walls and floors of equivalent fire resistance

I.23 Access panels in compartment walls and floors of equivalent fire resistance

I.24 Building services access kept locked and checked by facilities managers

LPS 1208

Published in 1995 and revised in 2014, LPS 1208: Issue 2.2 *LPCB fire resistance requirements for elements of construction used to provide compartmentation* provides guidance that may have been previously referred to by insurers when comparing the National BS 476 series to European test methods:

https://www.redbooklive.com/download/pdf/LPS1208.pdf

- Loadbearing compartment walls
- Non-loadbearing compartment walls and partitions
- External walls
- Curtain walls
- Cavity barriers
- Roofs where fire resistance is required (loadbearing and non-loadbearing)
- Loadbearing compartment floors
- Insulated panels used for enclosing production and storage areas in food factories

A future revision of BDM01 might consider a comprehensive comparison of National and European fire resistance test standards.

10.10 Principle J – Control Compartment Cavities

Principle J – Control Compartment Cavities

Design out cavities within the internal compartment walls and floors, so far as reasonably practicable, and where cavities are necessary, provide cavity barriers or fire stopping to prevent extensive routes for flame, heat, and hot or cold smoke.

J.1 Design out cavities or construct to be "fire sterile" and limited in extent

J.2 Intumescent materials to prevent the passage of flame, heat, and smoke

J.3 Cavities within internal compartment walls and floors as a risk in CDM 2015

J.4 Linear joint fire stopping tested to BS EN 1366-4 and checked in application

J.5 Fire stopping has the same fire resistance as the compartment wall and floor

J.6 Compartment wall and floor elements are fire stopped at their perimeters

J.7 Extensive cavities in long, high or labyrinthine elements are controlled

J.8 Installation of fire stopping as tested is photographed as Principle V

J.9 Service life of the fire stopping requiring no maintenance after installation

Recommendations

In Principle J, the recommendations are that:

- fire stopping is required within compartmentation, not a cavity barrier;
- fire resistance of fire stopping should be the same as for the element;
- elements should be fire stopped where they interconnect; and
- cavities in long, high or labyrinthine elements are not extensive.

These recommendations apply to cavities within both horizontal compartment floor elements and vertical compartment wall elements. Fire stopping of otherwise extensive cavities within compartmentation is important for Principle I, which relates to the enhancements in BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022.

https://www.thefpa.co.uk/resource-download/405

Testing elements

Fire resistance is tested through the element, from one side of the wall or floor to the other. Where cavity construction is present, the test equipment will seal the cavity perimeter, As a result, the test will not show what happens to flame, heat, and smoke that enters and travels through the cavity within the element to its unrestricted extent.

The extent of the cavity needs to be restricted or sealed by a cavity barrier or by fire stopping at the perimeter, and at sub-divisions within the element if the cavity is extensive.

It is necessary to disconnect one element from another element when both contain a cavity. This is important for cavities that interconnect inside the arrangement of internal compartment walls on compartment floor slab.

Party walls

The extensive cavity problem is compounded vertically in the case of party walls between buildings of different ownerships, as Principle L.1, where vertical cavities can connect to cavities in abutting walls or floors through several storeys. Such party wall cavities may be wholly or partially in external air with minimal weathering, and may be vulnerable to arson as Principle E.

Often, party walls are imperfectly extended as fire resisting walls through a pitched roof, creating a space above the ceiling to the top storey. Fire resisting construction shall extend to the roof to separate compartments below.

There was a notorious problem in the worst masonry terrace housing built cheaply for workers in the nineteenth century, where the cost of extending the acoustically poor but solid party wall was saved in the roof between chimney stacks.

If a breach of compartmentation is replicated in some twentieth and twenty first century development, where the party wall is cavity construction for acoustic reasons, the problem remains but also involves the cavity.

Compartment walls

Internal compartment walls must not have cavities that connect to pitched roof spaces, or cavities in flat roof construction.

Internal compartment walls and floors containing cavities must be disconnected from external walls containing cavities, as Principle K. This separation is required for acoustic performance, in addition to fire stopping.

Paired panel constructions in Light Timber Frame (LTF) or Light Steel Frame (LSF) can present the challenge of cavities not only between the panels, but also within the panels between the timber or steel "studs". Often the "double stud" or paired panel construction is required for acoustic performance, where the cavity is beneficial.

Robust details

Acoustic performance of repeatable wall and floor constructions for dwellings can be pre-tested and accredited through Robust Details.

https://www.robustdetails.com/

Robust Details are not mandated in Schedule 1 Requirements, as BDM01-11, but have been approved in statutory guidance as an alternative to pre-completion sound testing since 2004.

(E-AD-E)

Approved Document E: Resistance to the passage of sound

(2003 as amended 2004, 2010, 2013 and 2015)

https://www.gov.uk/government/publications/resistance-to-sound-approved-document-e

Robust Details should meet Annex E of BDM01-16 (E-AD-E), as Regulation 41 Sound insulation testing of the Building Regulations 2010.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/41

Robust Details has developed a similar service for legislation in Scotland and Northern Ireland.

https://www.robustdetails.com/other-services/robust-details-in-scotland/

https://www.robustdetails.com/other-services/robust-details-in-northern-ireland/

IQ8 Questionnaire

For Permanent Stacked Modular Buildings, as BDM01-10.1, RISCAuthority published the IQ8 Questionnaire and the Technical Checklist. These two related documents are organised against the Schedule 1 Requirements of the Building Regulations 2010, as they were in 2021:

- IQ8 *Building system questionnaire: Permanent Stacked Modular Buildings – Interactive*
  https://www.thefpa.co.uk/resource-download/394
- IQ8 *Permanent Stacked Modular Buildings: Technical Checklist for England*
  https://www.thefpa.co.uk/resource-download/395

CROSS 1065

The CROSS Safety Report 1065 *Volumetric modular buildings and fire*, published on 6 December 2021, refers to the IQ8 Questionnaire and the Technical Checklist.

https://www.cross-safety.org/uk/safety-information/cross-safety-report/volumetric-modular-buildings-and-fire-1065

CROSS Safety Report 1065 provides advice to several professionals involved with Volumetric Modular buildings, but advises insurers to:

- Consider requesting RISCAuthority's Form IQ8 *Building system questionnaire: Permanent Stacked Modular Buildings* to be completed by the client supported by their consultants and contractors
- Insist upon full disclosure of system fire tests for the cavity construction

For Authorities Having Jurisdiction (AHJ), the CROSS Safety Report 1065 says:

- Check that system fire tests for the cavity construction correspond with the installation of fire stopping at every instance in the volumetric modular stack

Use of the phrases "insist upon full disclosure of system fire tests" and "every instance" deserves emphasis. As does the statement that:

"Volumetric modular cavity fire stopping requires consistent installation in accordance with the system's fire resistance testing requirements, using only the materials and products that are tested for fire stopping, and proper installation during stacking and connecting the modules according to the manufacturers' instructions."

Connected cavities

In the case of Permanent Stacked Modular Buildings, there is no floor slab as a single compartment. Half-compartment walls are only configured when two Modules are stacked adjacent to each other, with a cavity between. Extensive cavities between the top and base of one Module may connect to cavities between the sides of Modules. These are further penetrated vertically by service risers or smoke ventilation shafts, and horizontally by escape corridors that abut segmentally. Protected escape stairs, lobbies, and lifts in wind resisting "cores" will be required to restrain the Modular stack, with other cavities between the configuration of "core" and adjacent Modules.

The labyrinth of interconnecting cavities between Modules cutting segmented compartments within the building envelope requires sophisticated fire stopping.

Requirement B3(4)

This makes Principle J.3 critical in a Permanent Stacked Modular Building to satisfy Requirement B3(4) in Schedule 1 of the Building Regulations 2010, as BDM01-11:

"The building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited."

Regulation 38

Without this design rigour in a Modular system, there is no record as Principle J.8, to be provided in entirety as part of the Regulation 38 Fire Safety Information exchange at handover, as Principle V.

No client should discover at handover Work Stage 6 that there is no Regulation 38 record of universal fire stopping installation consistent with any testing or, worse, that there is no testing of fire stopping representative of the project. Actions should be written into the Resilience Strategy as Principle A and managed under contract with the "Principal Contractor", even though they are not specified in legislation for health and life safety.

Regulation 40

The statutory guidance of Volume 1 Dwellings of BDM01-16 (E-AD-L)(2021), effective from 15 June 2022 in England, refers to Regulation 40 of the Building Regulations 2010, which requires information about use of fuel and power. There is no similar requirement for information in Volume 2 Buildings other than dwellings of (E-AD-L)(2021).

https://www.legislation.gov.uk/uksi/2010/2214/regulation/40

Regulation 40(2) insists that:

"The person carrying out the work shall not later than five days after the work has been completed provide to the owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances."

This (E-AD-Lv1)(2021) requirement should be insisted upon before handover, not up to five days afterwards. Yet it shows it is possible for the Secretary of State to write the statutory guidance with the force of law, to insist that every critical detail is digitally photographed, collated, and numbered to a logical arrangement for the client. Perhaps this approach will in future be extended to Regulation 38 of the Building Regulations 2010, as amended.

Photography in BREL

Section 9 of BDM01-16 (E-AD-Lv1)(2021) is about providing Regulation 40(2) information for new Dwellings in the form of a Building Regulations England Part L (BREL) Compliance Report to the building control inspector. The homeowner also expects to receive a signed copy. The content of the BREL Report is explained further in Appendix B Reporting evidence of compliance, in particular in points B7 and B8:

BREL B7

"Photographs should be taken of typical details as listed below and should be unique to each property. One photograph per detail should be recorded. Additional images, such as a close-up detail, should be provided only when necessary (see below). Photographs should be taken at appropriate construction stages for each detail when completed, but prior to closing-up works."

BREL B8

"Photographs should be digital and of sufficient quality and high enough resolution to allow a qualitative audit of the subject detail. Close-up photographs may be needed where a long shot image provides insufficient detail. More than one image of each detail may be needed. Geolocation should be enabled to confirm the location, date and time of each image. Each image file name should include a plot number and detail reference according to the numbers used in paragraph B7."

AD-L ahead of AD-B

The statutory guidance for Part L Conservation of fuel and power, in its expectation of comprehensive photographic evidence of critical construction under Regulation 40(2) of the Building Regulations 2010, as amended, is ahead of statutory guidance for Part B Fire Safety.

Photographic evidence should be expected in Regulation 38 of the Building Regulations 2010, as amended, particularly to address Requirement B3(4). This is a health and life safety requirement. But until the Secretary of State amends Regulation 38 to strengthen both Volumes of BDM01-16 (E-AD-B), investors should insist upon photographic evidence as Principle V, written into the Resilience Strategy as Principle A.

"Principal Contractors" may consider photographic evidence an imposition in either Volume of (E-AD-B), as housebuilders may do in (E-AD-Lv1)(2021). Modular system manufacturers should rather embrace this full disclosure as part of their offer to investors, and for their own handover procedure.

M&T Report

Most cavities in construction are simpler cases, but more variable in the way the elements are arranged, than the repeating cavities in Permanent Stacked Modular Buildings. However, cavities in Permanent Stacked Modular Buildings should be repetitively resolved with known movements and tolerances for a system of Modules. Testing of fire stopping is important in the fire situation for the Movements and Tolerances Report.

High-rise Modular

The emergence of urban high-rise Modular construction reaching up to 150m above ground level requires attention. These buildings may have a "Stay Put" policy for phased escape predicated on compartmentation, manufactured to a proprietary system, necessarily involving cavities between Modules in the compartmentation of floors and walls. A building that failed to address Requirement B3(4) in testing and consistent installation of fire stopping throughout cavities within compartment floors and walls could destroy the Modular business, were there a future cavity fire beyond the control of the Fire and Rescue Service. Particularly so if the fire proved fatal or injurious, in breach of the health and life safety purpose of the Building Regulations 2010.

- The 2010 Building Regulations require Part B Fire Safety in England achieves Life Safety, but how will the Fire and Rescue Service fight a cavity fire in urban high-rise Permanent Stacked Modular Buildings?
- Will the asset be a total loss?
- What would collapse mean for neighbouring buildings?
- How can it be demonstrated that the "offsite" manufactured Module stack was installed on site as-tested to achieve compartmentation?

"Offsite" to on site

Asking better questions in the design of Permanent Stacked Modular Buildings will elicit better answers to the legal requirement for health and life safety and the insurable risks in the "offsite" manufacturing, delivery, and on site installation of Category 1 MMC assets. To suggest fire will never get into cavities is negligent.

Modular webinar

The RISCAuthority webinar *Permanent Stacked Modular (and Podular) Buildings* provides further references.

https://event.on24.com/wcc/r/3531181/3BE01E15CFE87CDC5FF99D9362402A08

LPS 1501

It would appear that no Modular system has been awarded certification under the Loss Prevention Standard LPS 1501: Issue 1.1 *Fire test and performance requirements for innovative methods of building construction*.

https://www.redbooklive.com/download/pdf/LPS1501.pdf

FSF Working Group

Further collaborative work is being undertaken through a Volumetric Manufactured Off-site Modular Buildings Working Group, chaired by Chris Miles of FPA, and organised by the Fire Sector Federation (FSF). This follows publication of the White Paper *Developing a National Strategy for Fire Safety* in October 2022.

https://www.firesectorfederation.co.uk/wp-content/uploads/2022/10/FSF-Developing-a-National-Fire-Strategy-for-Fire-Safety.pdf

Fenestration

The Modular stack is weather protected in a building envelope of external walls and roofs that may also be cavity construction. However, the external arrangement of architectural fenestration and construction detailing is likely to be project specific, while the Modular system may be common to several projects.

Principle J applies to any cavity form of compartment wall or floor construction. It is not a Principle exclusive to Modular MMC. However Modular is an extreme form of internal cavity construction affecting Principles I and K in particular.

10.11 Principle K – Separate External Openings

Principle K – Separate External Openings

Slow the speed of external fire growth beyond the compartment of origin within external walls and soffits, separating openings with fire resisting construction, including attachments such as balconies, so far as reasonably practicable.

K.1 Protected zones at compartment walls and floors aligned as Principle I.5

K.2 External wall protected zones are non-combustible and fire resisting

K.3 Dimension protected zones in external walls with allowances for projections

K.4 Openings in the wall not located within protected zones unless fire resisting

K.5 Wall mounted plant and building services supported in the wall zones

K.6 Interfaces with fire stopping between walls and internal compartment walls

K.7 Alignment of cavity barriers with internal compartment walls and openings

K.8 Cavities in external walls provide no distribution route for building services

K.9 Linear joint fire stopping tested to BS EN 1366-4 and checked in application

K.10 Fire resisting construction is tested, installed, checked, and maintained

Requirement B4(1)

The passive fire protection of a compartment wall can be rendered ineffective as a consequence of an unprotected external wall:

- distorting from or collapsing to expose the edge of the internal compartment wall or floor; or
- being penetrated by a fire plume close to its interface with an internal compartment wall or floor.

Both will allowing direct flame or radiated heat to spread fire around the edge of the internal compartment wall or floor, either directly into adjacent compartments, or involving the external wall on the other side of the compartment line when combustible. A protected zone of non-combustible and fire resisting external wall construction, fire stopped where necessary to the front edge of the internal compartment wall or floor, should be provided to resist external fire spread.

BDM07 update

The protected zone of the external wall follows established thinking in BDM07 *Fire protection of buildings – Protected zone*, which may be updated to better align with BDM01, relating to the protected zone in the roof as Principle I and its relationship to Principle L.

https://www.thefpa.co.uk/resource-download/240

Product scale tests

Requirement B4(1) in Schedule 1 of the Building Regulations 2010, as BDM01-11, is addressed for health and life safety in BDM01-16 (E-AD-B) by product scale testing and classification to BS EN 13501-1 for combustibility, with the options for non-"Relevant Buildings" of system scale testing to BS 8414 or a fire engineering approach, and to BS EN 13501-2 for fire resistance. This is discussed as Principle D, and in some detail in BDM01-10.4.

The statutory guidance considers fire resistance to BS EN 13501-2 in the external wall, either to protect escape routes, which is obviously important, or to address the separation distance between neighbouring buildings. The separation between buildings is considered as Principle L.

Separating openings

Requirement B4(1) is not addressed in statutory guidance as a question of separation between openings. It is important not to disregard the separation between unprotected zones of non-fire resisting external wall construction that include but are not limited to windows, doors, and vents of architectural fenestration, with or without the presence of balconies.

Internal fire

There is a need to think about an initially internal fire collapsing non-fire resisting external wall structure or penetrating non-fire resisting external wall construction, to ignite combustible compartment construction or contents or a combustible external wall on the other side of the compartment wall or floor line.

Wall zone dimension

The dimension of the protected zone for the external wall should be agreed with the insurer as Principle B. The protected zone may not be the same dimension on both sides of the compartmentation. There may be advantages in varying dimensions to create an offset arrangement with an overall dimension. The protected zone may be varied according to locations of internal compartment walls or floors, or to facilitate openings. External wall abutments to projecting or recessed balconies with their soffits also require consideration.

Planning application

The protected zone is of architectural significance and will be iteratively revisited throughout the stages of the *RIBA Plan of Work 2020*, with the client referring back to insurers. Openings and projections should be resolved by submission of an application for Planning Approval, but minor amendments to the external wall for aesthetic and technical reasons will continue to be made.

Roof protected zone

A similar provision of protected zones in the roof is required as Principle I.

BS 476-10

Further guidance is available in BS 476-10:2009 *Fire tests on building materials and structures. Guide to the principles, selection, role and application of fire testing and their outputs*. This is particularly instructive for curtain wall. However, as the BS 476 series is being deprecated, improved thinking about the protected zone in the external wall is required. The protected zone in the external wall has been neglected in Requirement B4(1), and that neglect has a history.

LPC LPR 11 1999

Loss Prevention Council (LPC) LPR 11 *Fire spread in multi-storey buildings with glazed curtain wall facades* – 1999 is no longer published. There is renewed interest in the research carried out by Jim Glockling on curtain walling that requires fire stopping at internal compartment wall and floor edges. This research considered the benefit of sprinkler protection as an internal drencher, along with the protected zone as Principle K.

"Spandrel Panel"

Other researchers recognise the problem, such as Angus Law and Georgios Kanellopoulos, in "The rise and fall of the UK's spandrel panel", *Fire Safety Journal*, Volume 115, July 2020.

https://doi.org/10.1016/j.firesaf.2020.103170

https://www.pure.ed.ac.uk/ws/portalfiles/portal/154287189/Manuscript.pdf

The paper is informative and insightful, with a clearly written abstract:

"... research activities in the mid twentieth century led to a suggestion that the spandrel panel was not an effective means by which to mitigate storey-to-storey fire spread. Combined with the work of Margaret Law on unprotected areas, this led the UK national building regulations to omit the spandrel panel and, in effect, admit defeat with regard to

preventing storey-to-storey fire spread via openings in the external wall. The implications of this ... with phased evacuation or 'stay put' strategies are profound. If storey-to-storey fire spread is to be assumed, how should the fire safety strategy be reformulated to account for this? Or if the prevention of storey-to-storey fire spread is, in fact, an objective – what is the mechanism for doing this in the future?"

Post-war fire grading

The Joint Committee of the Building Research Board of the Department of Scientific and Industrial Research (DSIR) and of the Fire Offices' Committee (FOC) had prescribed separation between openings by simple dimensions in Ministry of Works (MoW) *Post-War Building Studies No. 20 Fire Grading of Buildings – Part I General Principles and Structural Precautions*, 1946, discussed as BDM01-10.8.

A non-combustible and fire resisting vertical separation between openings of at least 900mm (3ft), with at least 600mm (2ft) above the floor, or a non-combustible and fire resisting projection of 600mm (2ft), was prescribed as a minimal protected zone. This guidance characterised architectural fenestration until the late 1950s, when innovative lightweight cladding such as curtain walling attempting to span from compartment floor to floor challenged the orthodoxy.

FRN 436 1960

The Department of Scientific and Industrial Research (DSIR) and the Fire Offices' Committee (FOC) challenged their own orthodoxy when publishing L. A. Ashton and H. L. Malhotra, Fire Research Note FRN 436, *External Walls of Buildings – Part 1 – The Protection of Openings against Spread of Fire from Storey to Storey* in July 1960. This was based on work undertaken at the Fire Research Station, Boreham Wood, Hertfordshire.

https://publications.iafss.org/publications/frn/436/-1/view/frn_436.pdf

Projecting plume

Ashton and Malhotra argued that the fire plume emanating from the opening of the compartment of fire origin would attack the opening on the storey above regardless of a 900mm (3ft) vertical downstand or upstand, or a 600mm (2ft) projection, particularly in adverse wind conditions in both speed and direction. The widely referred to FRN 436 warned that, even with the protected zone separation between openings established in the *Fire Grading of Buildings* – Part I 1946, a fire would spread to the compartment above.

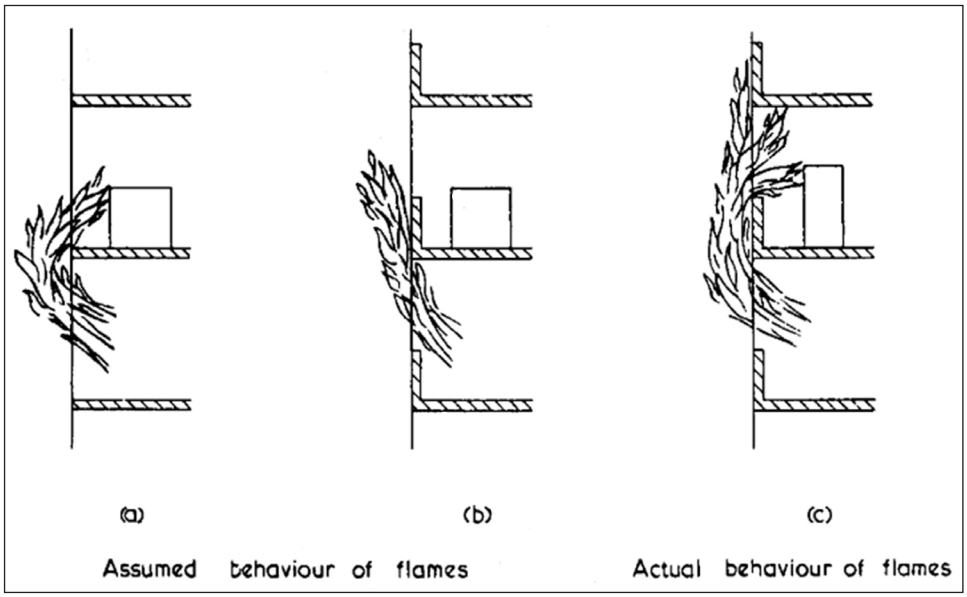

Figure BDM01-10.11.1 Assumed and actual shapes of flames, Figure 16 from FRN 436 1960 – L. A. Ashton and H. L. Malhotra – IAFSS

There appears to be no thinking about how rapidly fire might spread externally with or without a protected zone, or even how the geometry of non-combustible and fire resistant construction might be adjusted to afford more time before the compartment above became involved through the opening. There appears to be a focus on "... preventing storey-to-storey fire spread" instead of slowing it.

Building Regulations

Instead, the effort at separation of openings was entirely abandoned. The first National Building Regulations in 1965 were written with no prescription of separation between openings. Furthermore, nothing about separation between openings was reintroduced in the Building Act 1984, which empowered the Secretary of State to publish statutory guidance as BDM01-16, separate from but based on Schedule 1 Requirements as BDM01-11. Openings could be full height windows, doors or vents on a floor, or they could pass the compartment floor slab edge entirely, with or without an Insulated Infill Panel (IIP). While this suited curtain wall systems, it also led to talk of "screens" of windows, doors or vents, or of "window wall".

https://www.legislation.gov.uk/uksi/1965/1373/made

https://www.legislation.gov.uk/ukpga/1984/55

A new orthodoxy was created, that persists to the present, in which the use of fire resisting construction to achieve Requirement B4(1) is ignored, and only the combustibility of the external wall is considered a factor in external fire spread.

H. L. Malhotra 1986

Harbans Lal Malhotra published *Fire Safety in Buildings* in 1986 as his "personal view" at the BRE. He argued in Paragraph 7.46 and 7.45 that:

"External walls less than 1m from the boundary and for high rise buildings should have a non-combustible cladding ... The vertical separation between windows separated by compartment boundaries should not be less than 1m and the horizontal separation across a compartment wall not less than 0.6m ... This will prevent the possibility of fire spread from one compartment or from one occupancy to another by the external route."

Figure 7.3

Fire Safety in Buildings Figure 7.3 showed a 1.0m vertical separation between openings, and a 0.6m separation from opening to the centre of the compartment wall, or a 1.2m horizontal separation between openings across a compartment wall. It also included a protected zone of 2m over the roof, centred on the compartment wall. Malhotra also argued for greater projections at balconies, as he had done in FRN 436 of 1960. Figure 7.3 indicated fire resistance in the external walls above fire resistant roofs to lower buildings, suggesting the roof required fire resistance inside-out and the external wall required fire resistance outside-in.

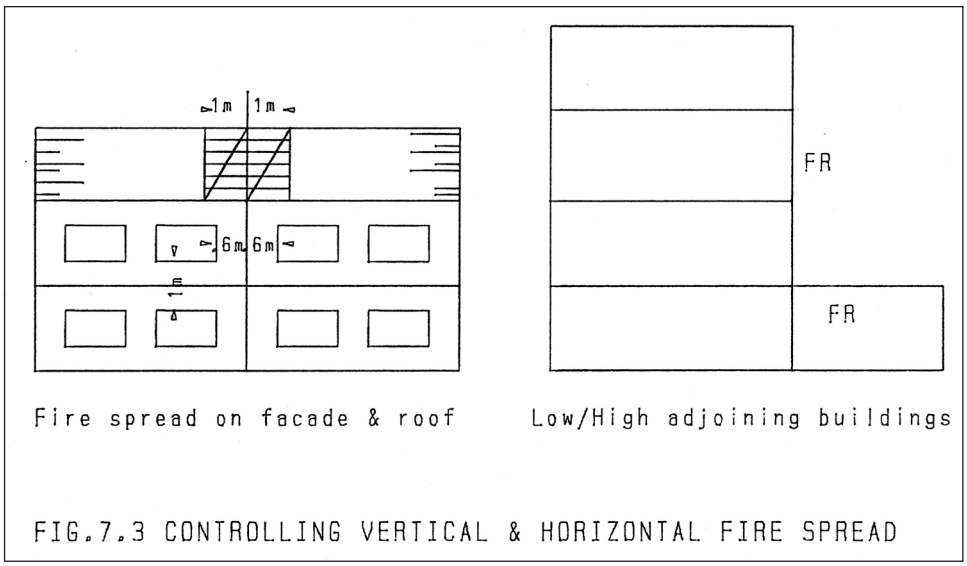

Figure BDM01-10.11.2 Figure 7.3, from Fire Safety in Buildings, 1986 – H. L. Malhotra – BRE

However, Malhotra's advice in 1986 was easily ignored in a "personal view", and was never adopted in BRE publications or statutory guidance.

https://www.brebookshop.com/details.jsp?id=328055

The statutory guidance expected Class 0 for high-rise buildings, or buildings within 1m of the "Relevant Boundary", and made no prescription for minimal separations between unprotected areas with openings.

Criticism of AD-B

The older H. L. Malhotra seemed to argue against the statutory guidance, and yet did not explain why vertical separation of 900mm was insufficient in the 1960s but 1000mm was sufficient in the 1980s. His FRN 436 stood, while his unexplained change of opinion in *Fire Safety in Buildings* was ignored. No further credible research on protected zones in the external wall or roof was done, even after 1992 when BRE published facsimiles of the *Fire Grading of Buildings* – Part I 1946 and *Fire Grading of Buildings* – Parts II, III, and IV 1952.

Wall fire resistance

Non-combustibility is insufficient. A floor-to-floor height spanning annealed glass curtain wall will shatter and fall away. Radiation will pass through the glass without it needing to shatter. In any case, opening vents may be open for fresh air. It is the deployment of fire resistance that is critical.

Large scale testing

As the Grenfell Tower Inquiry discovered, large system scale external wall fire tests continued through the 1990s. The BRE produced Fire Note 3 and 9 which, after the Garnock Court fire in 1999, led to BS 8414 with the pass/fail criteria in BRE BR 135 Second Edition. This was followed by the division of BS 8414 into two Parts, with BRE BR 135 *Fire performance of external thermal insulation for walls of multistorey buildings* – Third Edition published in 2013. There is explicitly no consideration in BR 135 assessment of external wall fire resistance.

https://www.brebookshop.com/details.jsp?id=327137

Autoexposure

The upward external spread of fire from opening to opening, involving another compartment each time, is called "autoexposure" by Vincent Dunn in *Safety and Survival on the Fireground* – Second Edition 2015. Autoexposure is also described as "leap frogging". The architectural fenestration of non-combustible and fire resisting construction across compartment lines may slow this process.

Rather than prescribe dimensions in Principle K between unprotected zones that may contain openings and projections or recesses with soffits, BDM01 takes the approach that separation between openings is a matter for consultation with insurers. The suggestion is to recognise the prescription in the *Fire Grading of Buildings* – Part I 1946, if not to adopt H. L. Malhotra's slightly enhanced 1986 guidance in *Fire Safety in Buildings*. Principle K.3 includes a suggested default.

Suggested default

Vertically, the protected zone in the external wall should be a minimum of 900mm across the internal compartment floor. This may be reduced only when a minimum 600mm fire resisting horizontal projection is provided where an opening is lowered to finished floor level or raised to the soffit of the compartment floor.

Clearly where there are doors in the external wall, they are either at ground, onto roof areas which may include terraces, or onto projecting balconies, and the protected zone can be dimensioned and delineated at these architectural features by agreement with the insurer as Principle B.

Three specifications

There are three specifications for external wall fire resistance, which are:

- Protected zones related to the fire resistance of compartmentation as BDM02 with allowance for fire resisting projections and geometric choice;

- Unprotected openings for non-fire resisting windows, doors, and vents outside of the agreed protected zone; and
- Remainder of the external wall with a minimum fire resistance of 30(EI) in which unprotected openings are located.

Should it then be necessary to include windows, doors, and vents in the protected zone, they shall have the same fire resistance and mechanically close. However, this eventuality is unlikely if the insurer has been consulted early to define the external wall protected zone and relate that as Principle I.5 to the roof.

M&T in fire situation

The expectation in BDM01 is that the Movements and Tolerances Report will address Principle K for non-fire and fire situations, either at the solid compartment wall front edge and the deflecting compartment floor "slab edge", or where there is vertical or horizontal cavity construction instead, as Principle J.

The external wall should have fire resistance at least equal to that required of the fire stopping or cavity barrier, with movements and tolerances within the construction recognised in testing as Principle S. It is important for consultants and contractors to appreciate how fire stopping and cavity barriers are applied in external wall constructions, and their field of application. Cavity barriers are discussed further as BDM01-10.17, when considering the "Lead Designer" role.

BS EN 1366-4

As with Principle J.4, Principle K.9 recognises linear joint fire stopping is tested to BS EN 1366-4:2021 *Fire resistance tests for service installations. Linear joint seals*.

However, this is a test for building service installations. It is used for fire stopping cavities within compartment walls and floors, and at their front edges where they abut the external wall constructions that are positioned to pass the slab edge entirely. This test is known to be unrepresentative of Movements and Tolerances in the fire situation for cladding systems that will distort in heat.

Principles D, K and L

Initially, autoexposure is addressed in Principle D by favouring non-combustible construction in the external wall. Additionally, autoexposure is addressed in Principle K by separation between openings and the deployment of fire resisting protected zones, with the Movement and Tolerances Report for the non-fire and fire situation resolved at fire stopping and cavity barriers.

The further factor of separation between buildings is discussed in Principle L.

10.12 Principle L – Resist Fire Ingress

Principle L – Resist Fire Ingress

Resist external fire ingress into the premises by party wall separation from any adjoining building, sterilisation of roofs, and control of external fire resistance with distance between neighbouring buildings, so far as reasonably practicable.

L.1 Adjoining buildings separated by compartment walls with protected zones

L.2 Roofs to resist ignition by radiation and "burning brands" carried in the wind

L.3 Calculate percentage of non-fire resistant unprotected area in external walls

L.4 Green roofs and walls considered as a variable ignitable external fuel load

L.5 Permanent external storage controlled by the facilities manager

Separating buildings

The factor of separation between buildings is embedded in legislation. This is the conflagration problem. Great fires in cities made of combustible materials were an early cause of legislative reform, leading to building regulation. The prospect of suffering a vast loss of property developed the insurance market too, and the insurance companies developed the early Fire Brigades.

Heat and "brands"

A building on fire in an urban area will radiate heat and produce "burning brands" that are carried in the wind, which can ignite neighbouring buildings in close proximity. This is partly a problem of combustibility in the wall and roof construction, as Principle D. However, the prospect of fire ingress from a neighbouring fire event is reduced by increasing the separation between buildings so that heat radiation or windblown burning debris cease to be problematic. This is not always possible at an urban density of development.

Radiant heat

The radiant heat problem of proximity was addressed by Margaret Law in Fire Research Note FRN 437, *Radiation from Fires and Building Separation*, May 1960.

https://publications.iafss.org/publications/frn/437/-1/view/frn_437.pdf

This is Paper 2 in the Arup commemoration of her life's work.

https://www.arup.com/perspectives/publications/books/section/engineering-fire-safety-some-selected-papers-from-margaret-law

Law's research inventing the "Relevant Boundary" led to BRE BR 187 *External fire spread: building separation and boundary distances* – First Edition 1991.

External fire spread

Calculations of the external wall, based on BRE BR 187 *External fire spread: building separation and boundary distances* – Second Edition 2014, and submitted in the building control application in compliance with Requirement B4(1) in Schedule 1 of the Building Regulations 2010, as BDM01-11, need to demonstrate a realistic assumption about external fire spread from one compartment to another.

https://www.brebookshop.com/details.jsp?id=327394

BR 187 contradiction

The separation distances and unprotected areas that are suggested in BRE BR 187 are explicitly based on the assumption that only one compartment is on fire at one time. This is a false assumption. BRE BR 135 correctly assumes that compartments above the compartment of fire origin will be involved in time, due to external fire spread, even when the external wall is non-combustible. The process of autoexposure, discussed as BDM01-10.11, will be faster when the external wall is more combustible, and fire resistance has not been deployed in a protected zone between openings. Autoexposure is a question of time.

Correction factor

A correction factor for BRE BR 187 is required for the maximum number of compartments the Fire and Rescue Service anticipate being involved before they can control the spread of fire over time, as Principle C.13.

External wall design maximising non-combustible materials, products, and systems as Principle D, and the protected zone as Principle K, may result in a smaller unprotected zone of openings for non-fire resisting windows, doors, and vents than is possible in the corrected BRE BR 187, subject to size of compartment, separation between buildings, and occupancy.

100% unprotected

In BRE BR 187, the unprotected area can potentially be 100% of the external wall with great separation between buildings. In other words, separation between openings can be zero if only separation between buildings is considered.

BDM01 vs BR 187

The BDM01 approach relates the protected zone to compartmentation, as BDM02, and takes a geometric approach to architectural fenestration as Principle K against autoexposure. In contrast, BRE BR 187 reduces the protected area to 0% of the external wall elevation, merging unprotected areas without providing protection of compartment wall and floor edges.

Interfacing cavities

A problem that is compounded when MMC presents cavity construction, as Principle J, to interface with the external wall construction, which may also include a cavity. The cavities perhaps including combustible materials, as Principle D.2. In such interfaces, it is necessary but difficult to know where the vertical or horizontal fire resisting compartment lines are located on the external wall elevation, or in cross-sectional detail. Those interfaces also having Movements and Tolerances.

BS EN 13501-5

BS EN 13501-5:2016 *Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests* uses a different classification approach. This involves tests for "burning brands" landing on roofs or balconies, their being blown by the wind, and the addition of radiant heat from the adjacent fire while that is happening.

Green roofs

Green roofs are also addressed in the 2013 MHCLG guidance *Fire performance of green roofs and walls*, referred to in Paragraph 10.7 in Volume 1 and Paragraph 12.7 in Volume 2 of BDM01-16 (E-AD-B).

https://www.gov.uk/government/publications/fire-performance-of-green-roofs-and-walls

A Green roof that has dried out is at risk of being ignited by a neighbouring fire, or by a source of ignition on the roof itself, such as faulty electrical services. This raises the prospect of fire entering the building from above.

A Green wall may also be ignited where radiant heat is intense due to proximity, or where "burning brands" become lodged in dry foliage. Integrated external wall lighting for further architectural effect may also provide an ignition source.

Planning application

The building control applications against Schedule 1 Requirements as BDM01-11 will be made at technical design resolution in Work Stage 4. However, a factor such as separation between buildings is fundamental to concept design as Work Stage 2, without which there is no spatial coordination in Work Stage 3. A planning application will be made sometime in Work Stages 2 or 3, when the architectural fenestration in the separation between openings, as Principle K, will need to be reconciled to the Principle L separation between buildings. If possible, Principles K and L need to be anticipated as part of the Resilience Strategy as Principle A.4.

Creative foresight

Fire ingress is a matter of building separation but it is also predicated on numerous technical decisions. Planning ahead requires creative foresight by the "Lead Designer". When arranging buildings on a site, it takes a leap of imagination to grasp how that will influence the construction.

Practical resolutions

Practical resolutions in Principles D to Y have their origins in the Resilience Strategy, which develops from the investors strategic definition in Work Stage 0, based in early consultation, with preparation and briefing in Work Stage 1. This work may be undertaken before the "Lead Designer" is appointed, but it might be advantageous to appoint the "Lead Designer" earlier. The creative act of design in Work Stages 2 and 3 cannot avoid practical resolutions. By Work Stage 4 effort turns into a problem of production among many consultants collaborating to budget and programme, often with the increasing involvement of the contractor.

10.13 Principle M – Expect Adverse Weather

Principle M – Expect Adverse Weather

Protect the building envelope against degradation from incident solar radiation, wind, and water, interrelated to thermal cycles, anticipating prospects of flooding, high rainfall, drought, and high wind, which may also complicate the event of fire.

M.1 Weathertight building envelope protects the construction from degradation

M.2 No degradable construction with fire performance exposed to the weather

M.3 Degradable construction is specified and procured as Principle T

M.4 Drainage of roofing, terraces, and balconies is designed for high rainfall

M.5 Fixings tested, designed, and installed in the expectation of high wind loads

M.6 Adverse weather is accounted for in the correction factor as Principle C.13

M.7 Computational Fluid Dynamics studies of the smoke control system

M.8 Protection is provided against lightning strike on the building as RC35

M.9 Green roofs and walls are constantly irrigated and maintained as Principle Y

Extensions of time

Clients and their contractors need to anticipate the impact of weather on their operations. Project execution is often delayed by exceptionally adverse weather conditions, resulting in claims for extension of time on a contract. The Royal Institution of Chartered Surveyors (RICS) publishes guidance on unforeseen weather as a claim for an extension of time.

https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/construction/black-book/extensions-of-time-1st-edition-rics.pdf

Beyond the construction phase in the contract, adverse weather needs to be anticipated in the design of the building as part of the Resilience Strategy.

Flood data sets

Flooding compounds the difficulty of access for the Fire and Rescue Service, and the RISCAuthority Fire and Flood Database is available to members here:

https://www.riscauthority.co.uk/members-area/toolkits/fire-and-flood-database

Weather data sets

The Chartered Institute of Building Service Engineers (CIBSE) provides weather data for the anticipation of conditions that might be expected over the design life of the building, and publishes "weather sets" for UK cities.

https://www.cibse.org/weatherdata

CIBSE TM49

CIBSE TM49 *Design summer years for London* – 2014 sets the summertime cooling needs of buildings in London. Reliable information for other locations is less readily available.

https://www.cibse.org/knowledge-research/knowledge-portal/technical-memorandum-49-design-summer-years-for-london-2014-pdf

Overheating AD-O

Approved Document O: Overheating as BDM01-16 (E-AD-O) was first published in 2021, for new residential buildings. This is a further factor in the design of glazed openings, although it does not consider temperature stabilisation effects of "thermal mass" that favour an exposed masonry or concrete structure as an early design decision.

(E-AD-O)

Approved Document O: Overheating

(2021)

https://www.gov.uk/government/publications/overheating-approved-document-o

Fenestration factors

The design of windows, doors or vents and curtain wall in England for the limited purposes of the Building Regulations 2010 means a creative synthesis of statutory guidance BDM01-16 (E-AD-B), (E-AD-C), (E-AD-E), (E-AD-F), (E-AD-K), (E-AD-L), (E-AD-M), and (E-AD-O) before a planning application is made on the architectural form and fenestration.

Before technical design at Work Stage 4, it is necessary to consider structural Movements and Tolerances, prospects of fire, rainwater and condensation, external noise, and high winds, meaning ventilation might not be a simple matter of opening windows. It is also necessary to consider glass safety, with the anticipation of glass replacement, solar gain, and hot or cold weather, along with levels of daylighting, privacy, and the achievement of a view. At Work Stage 4 the design synthesis of these factors, and more, requires technical resolution that has a grasp of commercial constraints.

Architectural role

During concept design at Work Stage 2, it is no simple task to broadly anticipate the interrelated technicalities that will present themselves later, perhaps only after tendering for the construction contract. Who other than the architect will achieve that disciplined arrangement of openings, and make them beautiful?

Façade engineer

This outline of technical complexity often results in the appointment of a façade engineer, who is expected to keep the external wall weather tight. Wind-driven rain water management and condensation are among the issues to be resolved by Work Stage 4. However, the façade engineer tends to develop the architectural intent, and not create it. Some façade engineers taking greater interest in fire.

SFE and CIBSE

The Society of Façade Engineering (SFE) is administered by CIBSE. The building envelope performance determines building services design as Principle F.

https://www.cibse.org/get-involved/societies/society-of-facade-engineering-sfe/about-facades

Ventilation AD-F

Ventilation for fresh air is influential in the design of openings. The windows, doors, and vents left open for comfort in hot weather, or on a windy day, may affect the fire event. This needs to be considered in the smoke ventilation approach, which is so important to the Evacuation Strategy. Ventilation in the non-fire situation may be confronted with a fire. This is acknowledged in "Selected key interactions with other parts of the Building Regulations", but hardly addressed further in (E-AD-F).

(E-AD-F)

Approved Document F: Ventilation

https://www.gov.uk/government/publications/ventilation-approved-document-f

(E-AD-Fv1) Volume 1 – *Dwellings* (2021)

(E-AD-Fv2) Volume 2 – *Buildings other than dwellings* (2021)

Mechanical systems can be designed to shift from fresh air ventilation to a fire situation mode. If separation between openings is planned as Principle K, a relationship between fresh air ventilation and fire safety might be more easily explored in the external wall. Resulting in design deliberation that recognises annealed glass shatters or windows might be open, and that smoke ventilation must not fail in adverse weather conditions, as Principle M.

Structural loads AD-A

It is easier to think about structure and adverse weather. The variables are more predictable in the external envelope that copes with the weather.

External walls are either loadbearing as part of the structure, self-supporting to ground and restrained back to a primary structural frame, or supported and restrained at every storey by the slab edge of a primary structural frame. The external walls need to integrate with the concerns of the structural engineer. The Institution of Structural Engineers (IStructE) published *Structural aspects of cladding* in 2020 as a replacement for their *Aspects of Cladding* in 1995.

https://www.istructe.org/resources/guidance/structural-aspects-of-cladding/

All weather loads on the external walls and roof must be supported by the structure during the non-fire situation, and for a period of time during the fire situation. Requirement A(1) of Schedule 1 of the Building Regulations 2010 is quite clear on that for England and Wales, as BDM01-11.

The English statutory guidance is derived from this requirement:

(E-AD-A)

Approved Document A: Structure

(2004 as amended 2010 and 2013)

https://www.gov.uk/government/publications/structure-approved-document-a

Structural Eurocodes

The EN Eurocodes are a series of 10 European Standards, EN 1990 – EN 1999, providing a common approach for the design of buildings and other civil engineering works and construction products. Each has a National Annex.

https://eurocodes.jrc.ec.europa.eu/

- BS EN 1991-1-1:2002 *Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings*
- BS EN 1991-1-2:2002 *Eurocode 1: Actions on structures – Part 1.2: General actions – Actions on structures exposed to fire*
- BS EN 1991-1-3:2003+A1:2015 *Eurocode 1: Actions on structures – Part 1-3: General actions – Snow loads*
- BS EN 1991-1-4:2005+A1:2010 *Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions*
- BS EN 1991-1-5:2003 *Eurocode 1: Actions on structures – Part 1-5: General actions – Thermal actions*
- BS EN 1991-1-6:2005 *Eurocode 1: Actions on structures – Part 1-6: General actions – Actions during execution*
- BS EN 1991-1-7:2006+A1:2014 *Eurocode 1: Actions on structures – Part 1-7: General actions – Accidental actions*

Non-loadbearing wall

The engineering of loadbearing external walls tends to give way to the advantage of a primary structural frame, where a Modular approach is not adopted. The external wall may be self-supporting to ground and restrained back to a primary structural frame, but this may compound Movements and Tolerances between frame and external wall with increasing height. More often the external wall has Movements and Tolerances at each storey on a primary structural frame.

The engineering of a non-loadbearing façade of precast concrete panels or curtain walling, supported and restrained outside the slab edge of the primary structural frame, requires the fire stopped interface to be resolved by a specialist cladding manufacturer, who may act as or through a specialist installation sub-contractor. Stone facings or brick slips can be cast

onto precast concrete panels to give the appearance of masonry. Sometimes, an unseen "grey" precast concrete panel will support built-up construction externally, instead of using an infill backing wall.

Built-up construction

The engineering of an external wall as a built-up construction often involves component materials and products procured from several manufacturers, and installed by specialist sub-contractors. All such built-up external walls involve a non-loadbearing infill backing wall supported on the slab edge and restrained at the top. Layers of construction are common as ventilated cavity rainscreen and non-ventilated cavity sealed panels, which may include brick slip carriers, all with support rails. Layers of construction are common as External Thermal Insulation Composite Systems (ETICS) which may or may not feature a drained cavity, and which may have brick slips adhered. All cavity constructions require cavity barriers as Principle K.

This aesthetic cornucopia of types of external wall construction does not always require a façade engineer when specialist manufacturers and installers provide design services, perhaps under contractor design provisions in contracts.

EOTA

Where standards cannot be identified as Principle Q, much external wall engineering relies on European Technical Assessments (ETAs) related to European Assessment Documents (EADs) published by the European Organisation for Technical Assessment (EOTA). Questions of mechanical failure from high wind loads, repeated wind induced movement, thermal expansion and contraction movements, or freeze–thaw cycles, for example, must be anticipated.

https://www.eota.eu/

External fixings

The Construction Fixings Association (CFA) represents the major manufacturers of fixing systems which are set in drilled holes, discussed further in BDM01-10.17.

https://www.the-cfa.co.uk/

External water risks

Successful weathering, and particularly wind-driven rainwater management in detailing, and the designing out of condensation risks, are measures of good technical design at Work Stage 4. The aesthetic quality of the design is maintained. Water absorption of thermal insulation could destroy building performance, so that BDM01-16 (E-AD-C) relates directly to (E-AD-L). In Schedule 1 Requirement C2 Resistance to moisture, as BDM01-11, attention is drawn to:

(b) precipitation including wind-driven spray

(c) interstitial and surface condensation

CWCT Standard

Founded in 1989, the Centre for Window and Cladding Technology (CWCT) is the membership funded centre of specialist knowledge and expertise for the external wall, and glazed constructions as roofs. CWCT publishes standards, guidance, and technical publications, while providing focused courses including the full or part time MSc in Façade Engineering in collaboration with the University of the West of England (UWE). The essential CWCT *Standard for Systemised Building Envelopes* was published in 2006, and has served the entire sector well:

"It is a registered document – each copy is numbered – and purchasers are automatically sent Technical updates by email as they are published. The CWCT Standard covers all forms of systemised envelope construction and their integration into a complex envelope."

https://www.cwct.co.uk/collections/standards/products/cwct-standard

Class 0 universally

The 2006 universal commitment to Class 0 in Part 6 Fire Performance of the CWCT Standard is now deprecated. The CWCT series of Technical Notes is available to members. The CWCT *Guidance on Built-Up Walls* is also essential reading.

https://www.cwct.co.uk/collections/guides-reports/products/built-up-walls

Insurers are advised to refer to the CWCT for guidance on wind-driven rain and condensation risk in the external wall, among many other potential issues to be resolved. However, the non-glazed roof also requires consideration, as do roof terraces that serve as balconies, which always interface with the external wall.

BS 8579 balconies

Many balconies are considered "specified attachments" of the external wall when projecting, or as roofs when recessed, both involving soffits. BS 8579:2020 *Guide to the design of balconies and terraces* is instructive. Roof, terrace and balcony issues include but are not limited to:

- High wind loads
- Heavy snow loads
- High rainfall overwhelming drainage
- Blockages at drainage and overflows
- Overloading with a weight of contents
- Combustibility of contents
- Ignition risk of activities

Shading devices

Shading devices are also "specified attachments" to the external wall, and can be a source of noise in wind, rain or hail. Their attachment, like that of balconies, requires attention to thermal bridging at connections and also requires structural engineering for high wind loads.

Irrigation

Green roofs and walls require irrigation as Principle M.9. Escape of water events consequent on frozen pipes in colder weather are further considered as Principle N. Exposed pipework may usefully be designed out, but may also be designed in when related to irrigation systems taken externally to Green roofs or walls.

Lightning strike

The building should be protected against lightning strike in accordance with RISCAuthority RC35 *Protection of buildings against lightning strike*.

https://www.thefpa.co.uk/resource-download/336

The risk control guidance outlines the basis of the risk assessment process set out in the BS EN 62305 series:

- BS EN 62305-1:2011 *Protection against lightning. General principles*
- BS EN 62305-2:2012 *Protection against lightning. Risk management*
- BS EN 62305-3:2011 *Protection against lightning. Physical damage to structures and life hazard*
- BS EN 62305-4:2011 *Protection against lightning. Electrical and electronic systems within structures*

Communications

Although the principle threat from a lightning strike is to life safety, RC35 also provides advice and guidance relating to the threat to property, which may cause considerable disruption, financial loss, and damage to electronic systems, computers, and communication links. This may have consequences for:

(E-AD-R)

Approved Document R: Infrastructure for electronic communications

https://www.gov.uk/government/publications/infrastructure-for-electronic-communications-approved-document-r

- (E-AD-Rv1) Volume 1 – *Physical infrastructure and network connection for new dwellings* (2022)
- (E-AD-Rv2) Volume 2 – *Physical infrastructure and high-speed electronic communications networks* (2022)

Designing against damage from lightning strike is an important aspect of the Resilience Strategy that must be integrated with the structure as Principle H.

10.14 Principle N – Minimise Consequential Damage

Principle N – Minimise Consequential Damage

Invest in measures to limit the extent of damage caused by heat, smoke, and water in the event of fire, and by escape of water incidents, ensuring assets and the environment are minimally affected, so far as reasonably practicable.

N.1 Design out materials that generate toxic smoke or melt to spread fire down

N.2 Design out porous materials damaged by the absorption of water or freezing

N.3 Waterproofing to capture and manage water from active systems or leaks

N.4 Isolate wet piped systems in unoccupied buildings unless part of resilience

N.5 In-service wet piped systems are isolated by readily identifiable means

N.6 Sprinkler system pressure is in accordance with the LPC Sprinkler Rules

N.7 Pressure of all water systems other than sprinkler systems limited to 3.0 bar

N.8 Drainage systems and water mains in separate waterproof service risers

N.9 Service risers and smoke shafts constructed with a waterproof upstand

N.10 Lift shafts and protected stairs are all provided with a drainage system

N.11 Compartment wall and floor construction restricts wider damage

N.12 Consider pollutants in runoff from suppression systems and firefighting

N.13 Agree runoff protection measures with the Environment Agency

N.14 Implement agreed runoff protection measures, and maintain as Principle Y

Escape of water risks

Both Requirement C1 Preparation of site and resistance to contaminants and Requirement C2 Resistance to moisture in Part C of Schedule 1 to the Building Regulations 2010, as BDM01-11, shall be satisfied in the development of the design and the execution of the construction.

RISCAuthority *ADG Insurer Requirements for Enhanced Escape of Water Protection and Safety in Building Plumbing and Water-Based Fire Suppression Systems* – Version 1.0 – 2021 shall be referred to. The 12 Essential Principles of that document fit into BDM01 A to Z of Essential Principles, and a subsequent Revision of the Insurer ADG will consolidate that coordination.

https://www.thefpa.co.uk/resource-download/396

Water regulations

The Insurer ADG relies upon the Water Supply (Water Fittings) Regulations 1999.

https://www.legislation.gov.uk/uksi/1999/1148/contents

The damage consequent on escape of water events can displace people from their homes, incur great disruption and financial cost and, in some instances, lead to businesses failing. Poorly designed and installed systems can also lead to serious personal injury and death through scalding for the very young and old within the home. Escape of water events remain the most costly peril faced by insurers in residential Purpose Groups 1 and 2.

Quality of work

Unlike electrical or gas installations, discussed as Principle U, there is no statutory requirement for persons installing or working on water systems to be qualified.

Groundwater

Groundwater provides a third of the "wholesome" or potable drinking water in England and maintains the flow of many rivers. In some areas, the groundwater supplies up to 80% of potable drinking water. To protect groundwater from pollution, the Environment Agency (EA) declares a Source Protection Zone (SPZ).

www.gov.uk/guidance/groundwater-source-protection-zones-spzs

NFCC and EA

Environmental protection measures were developed in 2017 between the National Fire Chiefs Council (NFCC) and the Environment Agency (EA). They are available online with an *Environmental Protection Handbook for the Fire and Rescue Service*.

www.ukfrs.com/guidance/environmental-protection?bundle=section&id=12717

Active agents

Active Fire Protection (AFP) measures in either fixed installations or in firefighting may continue to use regulated chemical agents that are harmful to either human health or the environment. Measures should be in place to directly protect firefighters and occupants during their use, and to capture the runoff for safe disposal to protect the wider public and the environment. RISCAuthority are publishing a series of Active Fire Prevention Guides for insurer Members at this frontier of knowledge. The AFPG series is currently:

- AFPG-01 *Active Fire Protection - Overarching Document* – September 2022
- AFPG-02 *Watermist* – September 2022
- AFPG-03 *Inergen/IG541* – September 2022
- AFPG-04 *Novec 1230* – September 2022
- AFPG-05 *Argonite/IG 55* – September 2022
- AFPG-06 *Nitrogen/IG100* – September 2022
- AFPG-07 *Heptafluoropropane/FM200* – September 2022
- AFPG-08 *Pentafluoroethane/HFC-125* – September 2022
- AFPG-09 *Carbon Dioxide* – September 2022
- AFPG-10 *Oxygen Reduction* – January 2023
- AFPG-11 *Aerosol Fire Protection* – January 2023
- AFPG-12 *Fluorine-free foam-enhanced fixed systems* – January 2023

Proposals to use any AFP measures shall be discussed with insurers as Principle B and the Fire and Rescue Services as Principle C in the development of the Evacuation, Fire, and Resilience Strategies as Principle A.

So far as reasonably practicable, the use of AFP measures that are harmful to either human health or the environment shall be designed out at the early Work Stages of the *RIBA Plan of Work 2020*. Where AFP measures are necessary for the protection of special hazards a fire engineering approach should be adopted as Principles B.2 and C.2.

Management

Control of potential fire products and effluent should be considered by the building owner or operator providing fire safety management as Principle W. Management of potential fire products and effluent involves placing practical conditions on building contents related to occupational use as Principle G.

Regulation 8

Regulation 8 of the Building Regulations 2010 dedicates Parts B and D of Schedule 1. to health and life safety, but there is silence in those Requirements on the toxicity of smoke, as BDM01-11. Consequently the statutory guidance as BDM01-16 (E-AD-B) and (E-AD-D) does not consider smoke as a toxic substance.

Smoke toxicity

In January 2018, a *Study to evaluate the need to regulate within the Framework of Regulation (EU) 305/2011 on the toxicity of smoke produced by construction products in fires – Final Report* was published by the European Commission. This considered updating the Construction Products Regulation (CPR) 2013, discussed as BDM01-12. This reports was written by Tim Yates in October 2017, and authored by BRE, consultants Ecorys and "cleantech" developers Vito.

https://ec.europa.eu/docsroom/documents/27346/attachments/1/translations/en/renditions/native

Published after the Grenfell Tower fire, the authors concluded as item 9 that:

"The potential dangers of smoke in general, including toxic smoke, leaking into or being generated in areas that are considered to be safe zones and / or escape routes need to be considered in new or amended existing regulations."

Health concerns

Published in 2010, *Fire Toxicity* by Anna Stec and Richard Hull provides essential reading on the immediate and long term effects of toxic smoke inhalation. The authors have also published "Assessment of the fire toxicity of building insulation materials", *Energy and Buildings*, Volume 43, Issues 2–3, February – March 2011, pages 498–506. The combustibility of cladding and insulation is considered as BDM01-10.4, in supporting notes to Principle D.

https://doi.org/10.1016/j.enbuild.2010.10.015

Professor of Chemistry and Fire Science at the School of Natural Sciences, University of Central Lancashire (UCLan), Richard Hull observes:

"Most fire deaths and fire injuries result from the inhalation of toxic smoke. However, outside the mass transport industries, smoke toxicity is completely unregulated, allowing furniture and building products to be sold which produce lethal quantities of toxic smoke when they burn."

https://www.uclan.ac.uk/articles/research/regulating-smoke-toxicity

Hazard recognition

Further reading is the 2008 publication *Hazards of Combustion Products: Toxicity, Opacity, Corrosivity and Heat*, by V. Babrauskas, R. G. Gann, and S. J. Grayson.

https://doctorfire.com/hazards-of-combustion-products-toxicity-opacity-corrosivity-and-heat/

Lack of regulation

The issue of smoke toxicity is noticeably absent from the Building Regulations 2010, as amended, despite Regulation 8 of the Building Act 1984. The construction is obviously different to the contents, varying by Purpose Group, with Furniture, Fixtures and Equipment (FF&E) also needing consideration.

Protection of the asset from smoke spread is an important quantitative issue for insurers, but the qualitative issue of smoke toxicity should be considered where both (E-AD-B) and (E-AD-D) are lacking for health and life safety.

10.15 Principle O – Facilitate Simple Repair **Service Life Planning**

Principle O – Facilitate Simple Repair

Develop the design to technically resolve how a partially damaged building can be cost effectively repaired and be vigilant against proposed changes in construction Work Stages that diminish repairability, which should be declined under contract.

O.1 Construction selected to be cost effectively repaired should it be damaged

O.2 Resilience Strategy to the BS ISO 15686 series for Service Life Planning

O.3 Technical hierarchy of primary, secondary, and tertiary components

O.4 Primary components are demonstrably cost effective to repair

O.5 Demonstrate how secondary and tertiary components are to be replaced

O.6 Practical experiments to cost effectively repair construction prototypes

O.7 Agree aesthetic qualities of repairs when damage remains visible after repair

O.8 Methods of repair recorded and samples of repairs kept at contract tender

O.9 Attempts at "Value Engineering" declined where repairability is diminished

Service Life Planning

The service life of materials, products, systems, and elements of the works should be declared in accordance with BS ISO 15686-1:2011 *Buildings and constructed assets. Service life planning. General principles and framework*, with a practical terminology as follows:

- **Primary components** that are structural, inaccessible, and prohibitively difficult or expensive to replace, with service life no less than the design life.
- **Secondary components** that are non-structural, accessible, and require major works to replace.
- **Tertiary components** that are non-structural, accessible, and require minor works to replace, which include components that will degrade rapidly to affect performance under anticipated conditions.

Durability terms

The service life for the primary, secondary, and tertiary components should be declared in accordance with BS 7543:2015 *Guide to durability of buildings and building elements, products and components*. The following terminology should be used to assess how components can be repaired, or whether they will need to be replaced in the event of accidental damage:

- **Lifelong**, where a primary component lasts for the life of the building without replacement or maintenance.
- **Maintainable**, where a non-replaceable primary component lasts for the life of the building with maintenance.
- **Replaceable**, where replacement is envisaged at design stage because a secondary or tertiary component has a shorter service life than the life of the building, even with maintenance.

Terminology developed in design for repairability should be explained to and understood by contractors procuring quality materials as Principle T, so it is consolidated into the verified recorded information as Principle V that will be used to keep maintenance commitments as Principle Y.

Proposition

Experiments that deliberately damage small prototypes of constructions with fire, smoke or water may provide intelligence to the project, and to insurers.

It might be proposed in future that RISCAuthority collate and anonymise such insight about damage as a resource for the insurer members. Such a study should be beneficial for clients, consultants, and contractors, if published.

Damage insight

Insurers will have data on the sorts of damage that are common. Damages to wet plastered and plasterboard walls and ceilings are likely to be high on the list.

A future revision of BDM01 may usefully consider the mundane damages that aggregate into exposure for insurers.

Anticipating how a building is to be repaired is the point of Principle 0, with a possibility that the work has to be done after a fire or water damage event. The Resilience Strategy needs to have the reasonable foresight to anticipate the difficulty that repair will involve. Some construction will be very ordinary. Other buildings will be almost impossible to repair without specialist knowledge in materials and methods that are a "trade secret", or proprietary to the system manufacturers. It is a peculiarity of Modern Methods of Construction (MMC) that their repairability often remains a mystery, even to customers.

Master Builders

The Federation of Master Builders (FMB) has the largest membership of small and medium-sized building companies across England, Scotland, Wales, and Northern Ireland. The practical test of whether a building repair is "simple" may be the ability of FMB members to undertake the work. Repair of Modern Methods of Construction (MMC), older system building methods, craft and trade techniques, or heritage buildings may be beyond the FMB membership needing steady work.

https://www.fmb.org.uk/

Crafts and Trades

There is a range of craft and trade techniques mastered by specialist contractors, which may be present in the restoration sector. Identifying good contractors is often a matter of personal recommendation, based on a reputation built over many years. Many smaller architects practicing locally pride themselves on knowing the best craft or trade specialists in their area. Often, an architect will be needed to draw together a number of specialist sub-contractors under a form of building contract, supporting the main contractor.

Historic England

The official name of Historic England is the Historic Buildings and Monuments Commission for England. It was first established in 1984 and until 1 April 2015 was commonly known as English Heritage (EH). A new charity, officially called the English Heritage Trust, took the name of EH, with responsibility for the National Heritage Collection of more than 400 state-owned historic sites and monuments across England.

https://www.english-heritage.org.uk/

EH published *Conservation Principles, Policies and Guidance* – April 2008. This guidance has been adopted by Historic England (HE).

https://historicengland.org.uk/images-books/publications/conservation-principles-sustainable-management-historic-environment/

Heritage buildings

The repair of buildings with heritage value may not be simple and, as Lloyd's Building illustrates, not all Listed Buildings are old. HE stress "... the objective of repair is to reduce the long-term deterioration of a building's fabric by remedying the cause of any defects. This in turn sustains the significance of the building, but to achieve this there needs to be sufficient information to understand the impact of the proposed repairs."

https://historicengland.org.uk/advice/technical-advice/buildings/principles-of-repair-for-historic-buildings/

Repair

Repair can be defined as "... work beyond the scope of maintenance, to remedy defects caused by decay, damage or use, including minor adaptation to achieve a sustainable outcome, but not involving alteration or restoration".

https://historicengland.org.uk/advice/technical-advice/buildings/maintenance-and-repair-of-older-buildings/

Conservation

EH provided a body of technical information for older properties, and a series titled *Conservation Basics*, published in print only in 2015 through HE.

https://historicengland.org.uk/advice/technical-advice/buildings/maintenance-and-repair-of-older-buildings/

https://historicengland.org.uk/images-books/publications/conservation-basics-conservation/

Thermal performance

The alteration or restoration of historic buildings for thermal performance improvement is difficult to achieve. Not all older buildings consist of what is unhelpfully referred to as "traditional" construction, yet the categorisation of a varied "non-traditional" building stock is no more helpful. HE published HEAG014 *Energy Efficiency and Historic Buildings – Application of Part L of the Building Regulations to historic and traditionally constructed buildings* in December 2017. First published by EH in 2011, this document is under review following the amendments to Building Regulations in 2022. The HE website provides further energy efficiency guidance.

https://historicengland.org.uk/images-books/publications/energy-efficiency-historic-buildings-ptl/

Scotland

Historic Environment Scotland (HES) similarly provides a body of knowledge. HES was created in 2015 through a merger between the Royal Commission on Ancient and Historical Monuments of Scotland (RCAHMS) and Historic Scotland (HS).

https://www.historicenvironment.scot/archives-and-research/publications/

Tower Blocks

Based previously at RCAHMS, there is a specific resource for the whole of the UK in the legacy of "Tower Blocks". This is largely thanks to Miles Glendinning, who with Stefan Muthesius wrote *Tower Block: Modern Public Housing in England, Scotland, Wales, and Northern Ireland*, kindly made available for free download.

https://towerblock.org/

https://towerblock.org/TowerBlock.pdf

"Ancient" buildings

The Society for the Protection of Ancient Buildings (SPAB) is another source of expertise for older buildings. SPAB has undertaken targeted on-site research into the energy efficiency of older building methods, finding that information for their successful repair was hard to obtain from observation or laboratory investigations alone. SPAB is supported by HE and HES.

https://www.spab.org.uk/

"Modern" buildings

The most obvious lack of guidance is for the simple repair of Modern Methods of Construction (MMC). Proprietary systems manufacturers do not appear to see the value in publication of assembly, maintenance, and repair manuals. There also seems to be little "aftercare" as might be expected from other industries.

Specialists

The specialist skills in the more "ancient" crafts, trades, and manufactures have been maintained and promulgated by many enthusiasts, some able to earn a living in repair work. Centres of specialisation are regionally based, but a notable example is the Weald and Downland Living Museum.

https://www.wealddown.co.uk/courses/

It always difficult to find specialists when work needs to be undertaken for the first time. Retaining contacts with the best operatives takes effort. A place to start might be Build UK, with their membership of trade associations who may be able to advise in particular sectors.

https://builduk.org/members/trade-association-members/

There are no doubt other networks to be recognised in a future revision of BDM01.

10.16 Principle P – Plan Salvage Operations

Principle P – Plan Salvage Operations

Plan enhanced protection and subsequent salvage of valuable building contents, so far as reasonably practicable, including any important or irreplaceable furniture, fixtures, and equipment, in ways compatible with firefighting operations.

P.1 Fire and Rescue Service consulted on the Emergency Response Plan

P.2 Irreplaceable contents are securely kept in non-combustible buildings

P.3 Buildings or large immovable objects have temporary property protection

Heritage Under Fire

In 1990, the Director of the FPA Stewart Kidd first published *Heritage Under Fire: A guide to the protection of historic buildings*, on behalf of the UK Working Party on Fire Safety in Historic Buildings, formed in 1986, following devastating fires at York Minster in 1984 and Hampton Court in 1986. After the fire at Windsor Castle in 1992, Alan Bailey, Donald Insall, and Philip Kilshaw produced *Fire protection measures for the Royal Palaces* for the Department of National Heritage (DNH), in 1993. A second edition of *Heritage Under Fire* in 1995 further incorporated the recommendations of that report, with a number of other lessons learned.

The DNH was created in 1992, amalgamating Ministry functions related to the arts, broadcasting, film, sport, architecture, historic sites, royal parks, and tourism. It was replaced by the Department for Culture, Media and Sport (DCMS) in 1997, renamed the Department for Digital, Culture, Media and Sport (DDCMS). The responsibility for the Fire and Rescue Services is with the Home Office.

Damage control

However, salvage in the context of "damage control" was only covered in outline in *Heritage Under Fire*. A specialised heritage loss prevention sector developed subsequently. In his paper *The Implementation of a Damage Limitation Project in a Heritage Context* in 2002, Stewart Kidd, working as a consultant, summarised the primary purposes of "damage control" as:

- Minimise the impact of a fire by restricting the spread of smoke and heat;
- Reduce the loss suffered by the organisation by relocating vital or significant items of the contents of a building to a safe place;
- Recovering important records or other key documents;
- Minimising the impact of firefighting activity by reducing the collateral damage caused by water;
- Protecting damaged buildings (against weather and intrusion) to prevent further loss or damage.

Strategic ERP

These themes may all be considered in an Emergency Response Plan (ERP), as part of the Resilience Strategy developed by organisations who have valuable building contents. The arrangements in an ERP should be discussed and developed with the Fire and Rescue Service, as Principle C. The aim is to ensure salvage operations are undertaken safely and that damage and long-term deterioration of the building and its contents are minimised.

HE guidance on ERP

Historic England (HE) provides guidance on how to prepare an ERP, and ensure employees or volunteers know how to respond in a dynamic emergency situation. Key staff, such as the duty facilities manager and salvage operation coordinators, need to be instructed and prepared for a range of reasonably foreseeable fire or water related events.

https://historicengland.org.uk/advice/technical-advice/emergency-and-fire/response-plans/

Training exercises

Before it became HE, English Heritage (EH) stressed the importance of training exercises with the Fire and Rescue Service, concerned to ensure their operational duties are not compromised in the ERP:

"Regular training exercises help test the plan and ensure that the people using the plan are familiar with it. Training which is practised under simulated conditions using the emergency plan, often provides the most realistic feedback in terms of the strengths and weaknesses of the plan."

The London Fire Brigade (LFB) also emphasises the importance of ERPs, through the Museum Association (MA), in *London Fire Brigade urges sector to complete fire emergency salvage plans* – October 2021.

https://www.museumsassociation.org/museums-journal/news/2021/10/london-fire-brigade-urges-sector-to-complete-fire-emergency-salvage-plans/

Issues to address

Issues to address in an ERP include but are not limited to:

- Inventory of salvageable objects
- Salvage priorities and contingencies
- Site and building plans for orientation of responders
- Simple procedures for the removal of items from locations – "Grab Sheets"
- First call to Fire and Rescue Service staff familiar with the response planning
- Contact list of the personnel responsible for salvage operations
- Contracts with trusted 24 hour emergency service providers
- Handling or access equipment and tools
- Temporary secure storage facilities locations
- Initial protective treatment in adverse weather
- Emergency care of salvaged objects during handling
- Arrangements for the longer-term storage or treatment of damaged objects

ERP templates

A three part guide to developing and updating an ERP is provided by HE:

Part 1: Templates for an Emergency Response Plan

https://historicengland.org.uk/content/docs/advice/erp-historic-buildings-pt1/

Part 2: What to do in an emergency.

https://historicengland.org.uk/content/docs/advice/erp-historic-buildings-pt2/

Part 3: How to treat and store objects after an emergency

https://historicengland.org.uk/content/docs/advice/erp-historic-buildings-pt3/

This is supported by templates:

Inventory of priority objects for salvage

https://historicengland.org.uk/content/docs/advice/inventory-priority-objects-for-salvage/

Salvage "Grab Sheets"

https://historicengland.org.uk/content/docs/advice/salvage-grab-sheet/

Practicalities

If a priority item is large or heavy to move, or if immovable parts of the building fabric are important, the "Grab Sheet" indicates how to divert threats from the fire or water event, or to protect the item on site, so far as reasonably practicable.

Specialist contracts

Advance contracting with trusted 24 hour emergency service providers should be arranged with experienced specialists.

Stopping safely

ERPs should identify how responders will know when to stop salvage operations because the fire or water event has become hazardous to health and life safety, without expecting to be told to stop and evacuate by the duty facilities manager or salvage operation coordinators.

10.17 Principle Q – Follow Identified Standards

Principle Q – Follow Identified Standards

Identify and closely follow standards for life safety and asset protection, avoiding selective "cherry picking" between standards, fully disclosing test reports and fire engineering assessments signed and dated by competent Fire Engineers.

Q.1 Design development identifies primary, secondary, and tertiary components

Q.2 Classification structure of the project specification facilitates comprehension

Q.3 Specifications are written either prescriptively or descriptively

Q.4 Standards specified or referred to shall be purchased, read, and understood

Q.5 Obtain confirmation from the building control inspector for new versions

Q.6 Manage the need for project specific performance testing as Principle S

"Golden Thread"

In May 2018, Judith Hackitt published *Building a Safer Future – Independent Review of Building Regulations and Fire Safety: Final Report*. Among the several recommendations was the proposal to create a "golden thread" of information as a digital record from initial design intent through to construction and including any changes that occur throughout occupation. Three regulated Gateways were proposed at planning, construction, and handover for occupation.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/707785/Building_a_Safer_Future_-_web.pdf

Digital BS 8644-1

As a direct response to the "golden thread" proposal, BS 8644-1:2022 *Digital management of fire safety information. Design, construction, handover, asset management and emergency response. Code of practice* was published. Like the Building a Safer Future report, this is directed to High Risk Residential Buildings (HRRBs), though the currently favoured acronym is Higher Risk Buildings (HRBs).

Gateways 1, 2 and 3

Gateway 1 is planning, by which time the "Lead Designer" has to develop the Evacuation, Fire, and Resilience Strategies, based upon a set of standards, as an "outline specification". Gateway 2 is the development of the specification through Work Stage 4 technical design, before the construction phase starts under contract. Gateway 3 is a regulated version of the existing legal requirement for a Regulation 38 Fire Safety Information exchange at handover, in Work Stage 6, as Principle V. The content of the Regulation 38 Fire Safety Information exchange requires the definition of the Evacuation, Fire, and Resilience Strategies in the earlier design phase. This may be considered a "golden thread".

Competent leaders

The competence of professionals such as the "Lead Designer" was a significant focus of the *Building a Safer Future* report. The RIBA embarked upon a review of competency for architects over their careers, called *The Way Ahead*.

https://www.architecture.com/-/media/GatherContent/Social-Value-Toolkit-for-Architecture/Additional-Documents/The-Way-Ahead-PDF.pdf

In 2016, President of the RIBA Jane Duncan argued that:

"The potential is there to magnify the architect's role as leader of the whole design, and building, process – a role we may have inadvertently conceded to others through relinquishing liability."

https://www.ribaj.com/culture/time-to-take-a-lead

In 2019, Dale Sinclair published *The Lead Designer's Handbook: Managing design and the design team in the digital age* through RIBA Publishing.

https://ribabooks.com/The-Lead-Designers-Handbook-Managing-design-and-the-design-team-in-the-digital-age_9781859467091#

Engineering UK-SPEC

The Engineering Council maintains the *UK Standard for Professional Engineering Competence and Commitment* (UK-SPEC). This sets out the competence and commitment required for registration as an:

- Engineering Technician (EngTech)
- Incorporated Engineer (IEng)
- Chartered Engineer (CEng)

IFE membership

Licensed by the Engineering Council, the Institution of Fire Engineers (IFE) is the professional institute through which fire engineers gain their qualifications. The IFE was founded in 1918.

https://www.ife.org.uk/Engineering-Council

https://www.ife.org.uk/Join/Chartered-Engineer

https://www.ife.org.uk/Join/IncorporatedEngineer

https://www.ife.org.uk/Join/EngineeringTechnician

Fourth Edition 2021

The Fourth Edition of UK-SPEC was published on 31 August 2020 and was implemented by 31 December 2021. The competences required for each of the professional registration titles should be sufficient for the design or construction being considered and signed for by any appointed fire engineer.

https://www.engc.org.uk/standards-guidance/standards/uk-spec/fourth-edition-to-be-implemented-by-31-december-2021/

IFE-ASFP Courses

The IFE collaborates with the Association of Specialist Fire Protection (ASFP) in examination levels for Passive Fire Protection, addressing:

- fire protection to the structural frame of the building and fire retardant coatings
- fire resisting walls, floors and ceilings and fire resistant glazing
- fire stopping and penetration seals, cavity barriers, ductwork and dampers and the building envelope
- fire resisting doors, industrial shutters and hardware.

https://www.ife.org.uk/Passive-Fire-Protection

Cornucopia

Many specialist standards exist for the cornucopia of materials, products, and systems that constitute a building, including Passive and Active fire protection measures. The process of writing and publishing standards involves a vast commitment of resources over time. For the "Lead Designer", the array of standards to consider can seem overwhelming. Leading practitioners have to organise ways of identifying and digesting available information.

Part of that discretionary task is to discover which standards may be insufficient to rely upon, where improvements can be made and augmentation is required.

BSI governance

The British Standards Institution (BSI) is a company governed by its Royal Charter and bye-laws. BSI is a "non-profit distributing company", and as such has no share capital, with profits re-invested back into the business.

https://www.bsigroup.com/en-GB/about-bsi/governance/

The BSI development process for British Standards and other standardisation products is governed by several key governance and policy documents. The governance documents set out the principles for the development of each type of standard and the principal features of the development process.

https://www.bsigroup.com/en-GB/standards/Information-about-standards/how-are-standards-made/The-BSI-Guide-to-Standardization/

BSI standards

The BSI publishes three kinds of standard:

- British Standards (BS)
- Publicly Available Specifications (PAS)
- BSI Flex.

Comparisons

The tendency will be to rely on British Standards. However, other influential standard writing authorities may be referred to. Many nations develop their own standard writing organisations, which may be influenced by conventions in other nations, or share knowledge at an international level. They include, but are not limited to:

- European Committee for Standardization (CEN) and European Electrotechnical Committee for Standardization (CENELEC)
  https://www.cencenelec.eu/
- International Organization for Standardization (ISO)
  https://www.iso.org/home.html
- American Society for Testing and Materials (ASTM)
  https://www.astm.org/
- International Code Council (ICC)
  https://www.iccsafe.org/
- National Fire Protection Association (NFPA)
  https://www.nfpa.org/
- CSA Group, formerly the Canadian Standards Association (CSA)
  https://www.csagroup.org/

Written specification

Specifications may be written by a specialist specification writer on behalf of the "Lead Designer". Alternatively, project staff may undertake the task, often using a proprietary specification software such as NBS Chorus. Writing adequate, concise, comprehensive, and comprehendible specifications is a skilled discipline. The easiest way to access the wealth of British Standards is through specification software, as a form of information management. However, making that information sensible and consequential requires a commitment to meaning that must be based in knowledge of design and construction.

https://www.thenbs.com/nbs-chorus

Uniclass 1 and 2

NBS Chorus is useful because it contains two classification systems. The construction industry used to classify materials and work to the Common Arrangement of Work Sections (CAWS), which was based on the familiar trades that subcontractors organised to. CAWS was Table J of Uniclass 1, and was considered out of date for a digital age. Many still prefer to use the more memorable alphanumeric of CAWS to the wholly digital numbering of Uniclass 2

that sought to replace it. Uniclass 2 has to be searched on a computer. The codes are like telephone numbers, but far more suited for information as metadata.

https://www.cpic.org.uk/publications/common-arrangement-of-work-sections/

Uniclass 2 to 2015

To develop other software tools that can make Building Information Modelling (BIM) and specification writing into a unified task for interacting consultants, Uniclass 2 was developed by NBS into a proprietary Uniclass 2015. This is based in 12 Tables, freely available online. The following have most relevance:

- Complexes
- Entities
- Spaces
- Elements
- Systems
- Products

https://www.thenbs.com/our-tools/uniclass-2015

https://www.thenbs.com/knowledge/what-is-building-information-modelling-bim

Materials

The development of Uniclass 2 was originally going to separate "Products" into:

- Products
- Materials

This was considered unnecessary for the NBS software in Uniclass 2015, and for BIM development in general, though construction still thinks in terms of materials.

Metadata

BIM and the ability to attach specification metadata to digital objects is a triumph of the early twenty-first century. Metadata-rich BIM is much more than a geometrical 3D Computer Aided Design (CAD) model. However, the veracity of the metadata and the quality of the design are still crucial. The content of the model determines the quality of the final building. The abilities of consultants and contractors remain as important as they were when buildings were drawn with ink pens on 2D paper and specifications were laboriously typed.

Read specifications

Consultants need to read and comprehend specified standards. Although standards are easy to specify by number and title, their practical meaning is important to understand. Comprehension requires experience of testing, product procurement, and site inspection of work methods, involving attention to and improvement of interface and joint detailing during the construction process. This is a life-long discipline of critical thinking as Principle Z and BDM01-10.26. Reading standards is not an academic exercise, whether or not standards are specified in BIM metadata.

BS 7974

The fire engineering approach to a higher quality of fire strategy is formalised in BS 7974:2019 *Application of fire safety engineering principles to the design of buildings*. This is the fire engineering standard discussed as Principle A for a Resilience Strategy, with a useful guide introduced by Peter Wilkinson.

www.bsigroup.com/globalassets/localfiles/en-gb/built-environment/bs-7974-fire-safety-brochure-web.pdf?id=431352

BS 9991 and 9999

In the absence of a fire engineering approach in BS 7974, the "Lead Designer" may be competent to add to their reading of statutory guidance by referring to:

- BS 9991:2015 *Fire safety in the design, management and use of residential buildings. Code of practice*
- BS 9999:2017 *Fire safety in the design, management and use of buildings. Code of practice*

However, BS 9991 and BS 9999 are still about health and life safety and, as such, are not adequate for a Resilience Strategy as Principle A.

Regulation 38 intent

Another technique in specification writing might be to work backwards from the Regulation 38 Fire Safety Information exchange, as Principle V. Knowledge of the issues at handover, in Work Stage 6, may inform design phase decision making.

Specialist standards

Sometimes it is useful for the "Lead Designer" to focus on standards that may appear specialist, to focus thinking on general issues. A good example is to concentrate on construction fixings, so that the choice of substrates in the primary structure or supporting construction is better considered.

Fixings and BS 8539

The Construction Fixings Association (CFA) represents the major manufacturers of fixing systems which are set in drilled holes. BS 8539:2012+A1:2021 *Code of practice for the selection and installation of post-installed anchors in concrete and masonry* is of great importance. They CFA also relies on ETAs to EADs by EOTA where standards do not exist. The performance of fixings in a fire situation is a CFA consideration. The CFA appears more concerned with the substantial market of internal construction, and significantly suspended building services as Principle F of importance to building services engineer. The CFA appears less concerned with the specialist market in external fixings that are exposed to adverse weather, as Principle M, which may instead concern façade engineers. Structural engineers being concerned to control all fixing methods into primary structure.

https://www.the-cfa.co.uk/Support/GuidanceNotes/

Critical Interfaces

A further technique is to identify "critical interface details" on the project, where the most onerous or difficult performance and alignment have to be achieved. This technique has long been advocated by the Centre for Window and Cladding Technology (CWCT), and it is familiar to architects. A starting point on "critical interface details" might be to identify cavity barriers and fire stopping.

Cavity barriers

Considerable construction industry effort has gone into products that have become differentiated as "Closed State" and intumescent "Open State" cavity barriers for cavities within external cavity walls. However, this is only one category of cavity construction, as important as it is. A wide range of internal construction relies upon cavity barriers for passive fire protection, as Principle I.

EOTA Assessment

The European Organisation for Technical Assessment (EOTA) produced EOTA TR 031 *Fire Resistance Tests for Cavity Barriers* in 2008. This remains current. While "Closed State" cavity barriers are addressed in EOTA TR 031, intumescent "Open State" cavity barriers are not. A test method for "Open State" cavity barriers was not available from EOTA.

https://www.eota.eu/technical-reports

https://www.eota.eu/sites/default/files/uploads/Technical%20reports/tr031.pdf

ETAG 026 Part 5

Published in February 2011, ETAG 026 *Guideline for European Technical Approval of Fire Stopping and Fire Sealing Products – Part 5: Cavity Barriers*, states in Section 1.3 that if the cavity barrier product is a reactive material or includes a reactive material, service life "... is assumed to be 10 or 25 years depending on available evidence." The maximum 25 year service life in ETAG 026 Part 5 is a limitation on "Open State" cavity barriers based on intumescent materials.

https://www.eota.eu/sites/default/files/uploads/ETAGs/2011-10-17-final-part-5-dierke-version.pdf

CPD 1989

EOTA initially published European Technical Approval Guidelines (ETAG) under the *Construction Products Directive 89/106/EEC*. ETAGs are now archived.

https://www.eota.eu/etags-archive

ETAGs to EADs

Following the *Construction Products Regulation (EU) No. 305/2011 (CPR)*, EOTA and the European Commission agreed that all commercially requested ETAGs would be converted into European Assessment Documents (EAD). The process is now complete.

https://www.eota.eu/eads

Intumescent

By necessity, intumescent materials in products and systems have to react to fire in their expansion to fill gaps. As such, they cannot obtain Class A2-s1,d0 to BS EN 13501-1. It is necessary to classify fire resistance performance to BS EN 13501-2.

ASFP TGD 19

The service life issue aside, the Association for Specialist Fire Protection (ASFP) developed TGD 19 *Fire Resistance Test for 'Open-State' Cavity Barriers used in the external envelope or fabric of buildings* – First Edition in July 2014. TGD 19 2014 is available as SIL00001540 on the Grenfell Tower Inquiry website. This was revised after the Grenfell Tower fire to ASFP TGD 19 *Fire Resistance Test for Open State Cavity Barriers* – Second Edition in November 2017.

https://asfp.org.uk/page/Publicationslist

prEN 1364-6

It is hoped that BS EN 1364-6 *Fire resistance tests for non-loadbearing elements. Part 6: Cavity barriers* will be published soon. The public comments phase for prEN 1364-6 was completed in June 2022. TGD 19 2017 will be redundant on publication of BS EN 1364-6. However, without publication, there is no European Norm for testing cavity barriers of any kind. Which is quite astonishing when so much depends on those components. The previous attempt at prEN 1364-6 collapsed in the committee procedure.

https://standardsdevelopment.bsigroup.com/projects/2021-03458#/section

EOTA TR 031 2008, the archived ETAG 026 Part 5 Cavity Barriers 2011, and TGD 19 2017 are the only guidance available for cavity barriers outside prEN 1364-6.

Inaccessible cavities

Attempts to apply "Open State" cavity barrier thinking to inaccessible cavities within internal compartment walls and floors has to address the maximum 25 year service life limitation of intumescent materials in ETAG 026 Part 5 Cavity Barriers 2011. That short service life limitation will remain with BS EN 1364-6, unless better evidence on the aged performance of intumescent components becomes available.

On Modular buildings, it is not sensible to address the problem of cavities between Modules within the compartmentation using cavity barriers, and particularly intumescent "Open State" cavity barriers with a short service life. This is discussed as Principle J, and use of fire stopping between Modules suggested instead.

BS EN 1366-4

It is possible to use fire stopping instead to BS EN 1366-4:2021 *Fire resistance tests for service installations. Linear joint seals* in the BS EN 1366 series that relates to Building Services, as Principles J.4 and K.9.

DIAP and EXAP

The Direct Field of Application (DIAP) and Extended Field of Application (EXAP) for tested products are discussed as Principle T.

A future revision of BDM01 may better consider the coverage of published ETAs and "critical interface details" in construction, involving drilled fixings, cavity barriers or fire stopping, where knowledge needs to be improved.

Manufacturer R&D

The complex and competitive businesses of membranes, gaskets, sealants, fixings, adhesives, fire retardants, fungicidal and insecticidal preservative treatments for timber, protective powder or paint coatings, and intumescent products are substantial. Product ranges, even after significant Research and Development (R&D), are often poorly considered in design and abused in construction. Some are excluded from Regulation 7(2) as BDM01-12. Many guard proprietary information from competitors and resist Principle V. Some become inaccessible after construction while others are a factor in maintenance as Principle Y.

10.18 Principle R – Provide Reliable Detection

Principle R – Provide Reliable Detection

Install a comprehensive automatic fire alarm system based on high-integrity detectors to prevent false alarms, so far as reasonably practicable, installed and commissioned by specialist operatives who should also provide user training.

R.1 Category P1 system including manual call points throughout the building

R.2 Integration of other systems to activate the detection and alarm system

R.3 BS EN 54 series compliance and the Alarm Receiving Centre

R.4 Communication of real fire signatures from high-integrity hardware

R.5 Smoke tight construction as Principle F.2 separating detection and alarm

R.6 Single system by third party certified specialists using quality components

R.7 User training in system operation provided to the facilities manager

R.8 Maintenance contracts with the original installer for a better service

R.9 Statutory duty holder remains continually satisfied throughout building use

Evacuation Strategy

The detection and alarm system must support the Evacuation Strategy as Principle C. This means a simultaneous or phased escape from all buildings other than Flats as Purpose Group 1a. Only in Flats is the "Stay Put" policy deployed, as BDM01-10.3, and that is contested as an Evacuation Strategy.

The "Lead Designer" entering the construction phase of Work Stage 5 should be able to relate the detection and alarm system to the Evacuation Strategy for health and life safety, and to understand the system required for property protection.

Alert systems in Flats

Before the Grenfell Tower fire, the approach to "Stay Put" had been NOT to alert the residents of Flats by a whole building alarm on fire detection. The development of BS 8629:2019 *Code of practice for the design, installation, commissioning and maintenance of evacuation alert systems for use by fire and rescue services in buildings containing flats* has introduced Evacuation Alert Systems (EAS).

The installation of a BS 8269 EAS allows the Fire and Rescue Service to manually activate an alarm in each and every Flat, in a system otherwise configured for alarm only in the Flat or only on the storey of fire origin. This provides a rudimentary but previously absent mechanism to begin to reverse the "Stay Put" policy at the discretion of the commander of attending firefighters.

If the system is not used, the residents in all Flats or storeys other than those of fire origin receive no alert. If sleeping, they may be unaware of a fire in the building. This modified "Stay Put" policy means residents remain potentially ignorant of an emergency, rather than self-evacuation being a matter of practised self-discipline. BS 8269 EAS is a compromise, requiring the Fire and Rescue Service to intervene. However, it is better than requiring firefighters to physically knock on each and every Flat door.

EACIE and PIB

BS 8269 EAS has led to manufacturing of Evacuation Alert Control and Indicating Equipment (EACIE), which shall be located adjacent to a Premises Information Box (PIB) for immediate access by the Fire and Rescue Service.

The EACIE, along with the PIB, is to be protected in a cabinet that is key operated by the Fire and Rescue Service, preferably suited to a standard key, manufactured to Loss Prevention Standard LPS 1175: Issue 8.1 *Requirements and testing procedures for the LPCB certification and listing of intruder resistant building components, strongpoints, security enclosures and free-standing barriers.*

https://www.redbooklive.com/download/pdf/LPS1175.pdf

Consideration may be given to the EAS having a communications functionality, to allow the Fire and Rescue Service to speak to residents of Flats. The immediately accessible and visually prominent locations of these facilities, and their functions, shall be agreed in consultation with the Fire and Rescue Service as Principle C.

BAFE SP207

The BAFE SP207 *Design, Installation, Commissioning and Maintenance of Evacuation Alert Systems Scheme* applies.

https://www.bafe.org.uk/become-bafe-registered/bafe-sp207-assessment-and-registration-process

Systems integration

The aim should be to realise an Integrated Fire Safety System (IFSS) that can be annually checked and recertified in a System Integration Test (SIT). With a department in the UK co-located with the FPA in Blockley, Gloucestershire, the Danish Institute of Fire and Security Technology (DBI) has promoted installation and commissioning of an IFSS in all buildings other than Dwellinghouses. In Denmark, occupation may be legally denied on serious failure of an annual SIT.

https://dbicertification.co.uk/

Category PD1 or P1

As an enhancement on a Category L system for life safety in Section 1 of both Volumes of BDM01-16 (E-AD-B) a detection and alarm system should be installed to BS 5839 *Fire detection and fire alarm systems for buildings*. The installation for domestic premises in Part 6 shall be to Category PD1, and the installation for all other non-domestic premises in Part 1 shall be to Category P1, to additionally include manual call points throughout the building.

BS 5839 series

The BS 5839-1 series specifies three categories of system:

- Category L for the protection of life (adopted by statutory guidance)
- Category M for manual fire detection and alarm systems
- Category P for property protection

False alarms

Some fire and rescue authorities will no longer respond to a report of the actuation of a fire alarm unless it is backed up by a confirmation emergency call. Therefore, design of a fire alarm system must reduce the chances of a false fire alarm to as near to zero as possible, to increase the confidence of the Fire and Rescue Service in the validity of signals from automatic fire detection systems. Refer to:

- BS 5839-1:2017+C1.2018 *Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises*
- BS 5839-6:2019+A1:2020 *Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises.*

Other Parts of the BS 5839 series are current but may be under review by the BSI:

- BS 5839-3:1988 *Fire detection and alarm systems for buildings. Specification for automatic release mechanisms for certain fire protection equipment*
- BS 5839-8:2013 *Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of voice alarm systems*
- BS 5839-9:2011 *Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of emergency voice communication systems*

BS 7273 series

Sprinkler systems as Principle I are known to be reliable and very rarely activate in non-fire situations. For reliable notification of fire in addition to their function as fire suppression they should be integrated into a detection and alarm system.

Where other systems are installed, they shall be interfaced to activate the BS 5839 Category P1 detection and alarm system to the relevant Part of BS 7273 *Code of practice for the operation of fire protection measures*, among the following:

- BS 7273-1:2006 *Electrical actuation of gaseous total flooding extinguishing systems*
- BS 7273-2:1992 *Mechanical actuation of gaseous total flooding and local application extinguishing systems*
- BS 7273-3:2008 *Electrical actuation of pre-action watermist and sprinkler systems*
- BS 7273-4:2015+A1:2021 *Actuation of release mechanisms for doors*
  [With an Expert Commentary published May 2017]
- BS 7273-5:2008 *Electrical actuation of watermist systems (except pre-action systems)*
- BS 7273-6:2019 *Fire detection and fire alarm systems. Interface with ancillary systems and equipment*

BS EN 54 series

Within the BS EN 54 *Fire detection and fire alarm system* series, high-integrity detectors are either single-sensor or multi-sensor devices which can be arranged in systems. Manual call points should be installed throughout the building as an additional provision.

The detection and alarm technology, capable of robust differentiation of false, unwanted, and real fire signatures, should be provided to communicate real fire signatures to an Alarm Receiving Centre (ARC). High-integrity detectors require specialist commitment to inspection, testing, and maintenance as Principle Y.

British Approvals for Fire Equipment (BAFE) manage and maintain the quality of work scheme for detection and alarm systems, discussed as BDM01-10.21.

10.19 Principle S – Complete Performance Tests

Principle S – Complete Performance Tests

Programme and decisively complete specified and contracted performance testing, inspection, and certification to show compliance, and achieve client acceptance of results in a timely manner, to prevent performance deficiencies under contract.

S.1 Specify project performance tests that shall be completed to a programme

S.2 Schedule submittals identified in the project Specification, including tests

S.3 Contractors issued with project Specification Submittal List at tender stage

S.4 United Kingdom Accreditation Service (UKAS) accredited test authorities

S.5 Programme for the eventuality testing may fail and retesting is necessary

S.6 Programme acceleration and cost savings are no reason for test cancellation

S.7 Smoke Leakage (S) rate for smoke ventilation shaft and compartmentation

S.8 Tested construction smoke toxicity when considering combustible materials

S.9 Welcome witnesses of critical project specific performance tests

S.10 Full disclosure of third party certified test reports and assessments

STICC

Testing, Inspection, Certification, and Compliance (TICC) is an acronym used by service providers in those fields. BDM01 suggests the extended discipline and acronym of Strategy, Testing, Inspection, Certification, and Compliance (STICC).

Strategic purpose

Without the Evacuation, Fire, and Resilience Strategies, there is no purpose that can be turned into a specification for TICC. The investor driven Resilience Strategy as Principle A, discussed as BDM01-4, defines the purpose of the design beyond the legal minimum of health and life safety, to be realised in the construction.

In terms of *Building a Safer Future* 2018, STICC may be thought of as:

Gateways

- Gateway 1 Planning Evacuation, Fire, and Resilience Strategies
- Gateway 2 Construction Testing, Inspection, and Certification
- Gateway 3 Occupation Compliance with the investor Strategies

Compliance

The aim of "compliance before occupation" at handover in Work Stage 6 will be limited to health and life safety in an Evacuation and Fire Strategy if compliance solely with legislation is all that is meant. If the wider purpose is strategically defined by the investor in a Resilience Strategy, before planning application, the meaning of compliance will be strengthened additional to health and life safety.

The Resilience Strategy will be more onerous than statutory guidance predicated on the limitations of the Building Regulations, which are themselves silent on, or even mistaken about, some health and life safety factors.

Only with a Resilience Strategy will the Regulation 38 Fire Safety Information exchange be about more than health and life safety, as important as that is. Fire Safety Information exchange valued by investors and insurers has to start in a Resilience Strategy. This is further discussed as Principle V in BDM01-10.22.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/38

FPA Lab services

The FPA Fire Research and Test Laboratory can assist in the STICC discipline as Principle S, with standard or bespoke testing, and welcomes enquiries.

https://www.thefpa.co.uk/fire-testing

UKAS accreditation

It is the view of the United Kingdom Accreditation Service (UKAS) that:

"Accreditation determines the technical competence, reliability, and integrity of Conformity Assessment Bodies. It spans all aspects of our everyday lives to provide confidence that accredited organisations are competent and can be trusted to deliver promised levels of performance and protection for the products and services we rely on ... The provision of accreditation must:

- Be undertaken impartially;
- Be objective, transparent and effective;
- Employ highly competent assessors and technical experts in all fields;
- Use assessors (and subcontractors) proven to be reliable and ethical in their approach to accreditation and their respective technical fields.

Accreditation drives confidence in all sectors by underpinning quality of results, ensuring their traceability, comparability and validity. UKAS accreditation guarantees the highest levels of impartiality and competence through the continuous assessment process."

https://www.ukas.com/accreditation/

The Fire Protection Association Ltd is UKAS accredited to BS EN ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*, with the unique and revision controlled FPA Schedule of Accreditation 10536 Issue No: 007 of 3 August 2022 available here:

https://www.ukas.com/wp-content/uploads/schedule_uploads/00002/10536Testing-Multple.pdf

Contact email

Contact the FPA Head of Fire Testing and Experimental Unit, Stephen Howard:

showard@thefpa.co.uk

10.20 Principle T – Procure Quality Materials

Principle T – Procure Quality Materials

Insist upon the procurement of materials, products, and systems with third party certification schemes accredited by the United Kingdom Accreditation Service, with proof of service life in application and full disclosure of fire safety information.

T.1 Satisfy Regulation 7(1)(a) of the Building Regulations 2010

T.2 Terminology for Principle O explained to and understood by contractors

T.3 Check certification of manufacturers by Conformity Assessment Body (CAB)

T.4 Direct Field of Application (DIAP) and Extended Field of Application (EXAP)

T.5 Full disclosure of as-tested specimens or prototypes in DIAP test reports

T.6 Complexity of EXAP assessment and competence of the assessor

T.7 Concealed fire protection is designed for practical verification as Principle V

T.8 Suitability of as-built fire protection after change of use or construction

T.9 Refurbishment is undertaken and completed while unoccupied between uses

T.10 Comprehensive automatic fire detection and alarm system as Principle R

T.11 Fire Safety Information for Regulation 38 in the Building Regulations 2010

Regulation 7

Construction products shall satisfy the requirements of Regulation 7(1)(a) of the Building Regulations 2010, as amended 2018 and 2022, as BDM01-12.

The Construction Products Regulation (CPR) for which AD7 (2013) was written has been superseded in the UK, since leaving the European Union.

www.legislation.gov.uk/uksi/2013/1387/contents

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/443280/BR_PDF_AD_R7_2013.pdf

CE mark

After a year of transition, adoption of the CE mark in the UK ended on 1 January 2022. The CE mark belongs to countries that are part of the European Union.

www.gov.uk/guidance/construction-products-regulation-in-great-britain

UKCA mark

The UK Conformity Assessed (UKCA) mark is intended for construction products on the market in Great Britain (England, Scotland, and Wales), substituting the EU requirements for the CE mark, which will continue to be accepted in Northern Ireland. The intention was to end recognition of the CE mark in Great Britain by 1 January 2023, but that has been delayed by government until 1 January 2025.

https://www.gov.uk/guidance/construction-products-regulation-in-great-britain

Fitness for purpose

Neither the UKCA mark nor the CE mark to the appropriate product standard or technical agreement shows that a material, product or system is "fit for purpose".

Informed judgement

Professional judgement is required about the application for which the product will be used, and such judgement requires reliable product information from manufacturers. To address the issue of product information, a Marketing Integrity Group was established by the Construction Products Association (CPA).

www.constructionproducts.org.uk/our-expertise/technical-and-regulatory-intelligence/hackitt-regulations-review/marketing-integrity-group-mig/

CPA intentions

The report of *Initial Findings* published in 2019 identified further work for the CPA:

www.constructionproducts.org.uk/publications/technical-and-regulatory/construction-product-information-survey/

The CPA concluded that product information should be:

- Clear;
- Accurate;
- Up to Date;
- Accessible; and
- Unambiguous.

This aspiration does not define full disclosure. An industry-wide consultation on a proposed Code ran in the spring of 2021, and further development is necessary.

Full disclosure

Discussed as Principle S in BDM01-10.19, the discipline of Strategy, Testing, Inspection, Certification, and Compliance (STICC) will be frustrated without full disclosure by manufacturers within the limits to confidentiality set by investors in a building, who may be retaining the asset or selling it to another owner.

Quite often, adverse Testing, Inspection, Certification, and Compliance reports never reach the Regulation 38 Fire Safety Information exchange or the Building Manual. Buyers may suffer a lack of full disclosure by the speculative investor.

In failing to provide full disclosure to insurers as Principle B, investors or owners may be jeopardising the terms and conditions of insurance policies.

In failing to provide full disclosure to the Fire and Rescue Service as Principle C, investors or owners may be jeopardising the Evacuation, Fire, and Resilience Strategies that have been produced by great effort. In some cases, health may be damaged and lives lost by the lack of full disclosure within the limits to confidentiality set by investors in or owners of a building.

The question of full disclosure to building users is a different ambition. However, it is an aspect of Principle W in the management of fire safety. After the Grenfell Tower fire, residents of Flats in particular, but also other occupiers across the Purpose Groups discussed as BDM02, are demanding full disclosure beyond the limits to confidentiality set by investors in a building. Occupants want to know what owners have done to ensure their health and life safety, and to protect their property including irreplaceable contents as an aspect of the Resilience Strategy.

Full public disclosure

Further full public disclosure, beyond the confidentialities agreed between owners and occupiers of a building, is also expected as a societal benefit. At a professional level, a curated anonymity is sustained in the publication of CROSS Safety Reports. This falls short of full public disclosure. CROSS Safety Reports are not written to be read by the public, and redact commercial or proprietary information. This is a frontier of knowledge challenged by advocates of full public disclosure.

Confidentiality

The discipline of full disclosure by manufacturers, within the limits to confidentiality set by investors in a building, is important for passive and active fire protection products and systems. Testing, Inspection, Certification, and Compliance (TICC) reports remain the intellectual property of the "sponsor" who paid for them. Terms and conditions of TICC service providers have strict confidentiality clauses. The strategy of STICC may recognise this confidentiality.

Manufacturers need to maintain their programmes of Direct Field of Application (DIAP) testing or Extended Field of Application (EXAP) assessment for specific applications. They often consider knowledge to be their intellectual property.

Power of investors

Conversely, if manufacturers want the business of investors, full disclosure should be insisted upon, even if that full disclosure is not extended to subsequent owners and occupiers of buildings, or as full public disclosure. Investors have buying power in the procurement decisions their "Principal Contractor" is contracted to make. They should make every effort to ensure their "Principal Contractor" keeps them informed. Confidentiality is not wilful ignorance.

"Desk top studies"

Principle D.8 rejects "desk top studies" as Building Control Alliance (BCA) Technical Guidance Note 18 *Use of Combustible Cladding Materials on Buildings Exceeding 18m in Height*, which is not approved by the Secretary of State.

BS 9414

BCA "desk top studies" are certainly not the same as BS 9414:2019 *Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests*.

BS 9414 assessments using BS 8414 system test results with BRE BR 135 assessment reports may not be considered EXAP tests in the way that simpler fire engineering assessments can be made at the level of products. BS 8414 system testing has many variables, so the veracity of extrapolations or interpolations is unclear. BS 9414 has advocates, but it may be little used.

PFPF

The Passive Fire Protection Forum (PFPF) produces guidance on undertaking fire engineering assessments, originally developed by the Fire Test Study Group (FTSG) in 2000. This guidance addresses both the complexity of the assessment and the competence level of the assessor in training and experience:

- *Guide to undertaking assessments in lieu of fire tests – 2000*
- *Guide to undertaking technical assessments of fire performance of construction products based on fire test evidence – Industry Standard Procedure – 2019*
- *Guide to undertaking technical assessments of fire performance of construction products based on fire test evidence – Industry Standard Procedure – 2021*

https://www.firesectorfederation.co.uk/wp-content/uploads/2021/02/Guide-to-Undertaking-Technical-Assessments-of-the-Fire-Performance-of-Construction-Products-Based-on-Fire-Test-Evidence-2021-1-2.pdf

The Fire Sector Federation (FSF) supports the PFPF. The list of trade associations supporting the PFPF guidance on undertaking technical assessments is substantial and may change. Any differences between these dated PFPF guides should be considered when reading the legacy of fire engineering assessments.

BS EN 15725

EXAP Reports shall be produced to BS EN 15725:2010+C1.2012 *Extended application reports on the fire performance of construction products and building elements*. This standard is currently under review.

CEN/TS 15117

BS EN 15725 is based on DD CEN/TS 15117:2005 *Guidance on direct and extended application*.

CWFT

The PFPF guidance on undertaking technical assessments provides advice on products that are Classified Without Further Testing (CWFT), referred to in the English statutory guidance BDM01-16 (E-AD-B).

Market leaders

The best manufacturers commit to full disclosure of DIAP testing and provide EXAP assessment within the limits to confidentiality set by investors in a building. The very best manufacturers offer full public disclosure knowing they are market leaders with techniques in manufacture their competitors are unable to match.

Best trade practices

Manufacturers also encourage best practices among the members of trade associations in the sectors they supply. The supporting notes BDM01-10.6 for Principle F and BDM01-10.9 for Principle I referred to the collaborative *Firestopping of service penetrations – best practice in design and installation*.

https://www.thebesa.com/technical/publications-knowledge/fire-stopping-of-service-penetrations/

The collaborating trade associations were:

- Association for Specialist Fire Protection (ASFP)
  https://asfp.org.uk/
- Building Engineering Services Association (BESA)
  https://www.thebesa.com/
- Building Services Research and Information Association (BSRIA)
  https://www.bsria.com/uk/
- Finishes and Interiors Sector (FIS)
  https://www.thefis.org/
- Gypsum Products Development Association (GPDA)
  https://gpda.com/

Linear seals, such as those around fire door frames and doorsets, or at deflection heads in walls, are explicitly excluded from the scope of this guide for building services penetrations. Similarly, cavity barriers are not addressed.

ASFP commitments

The full range of passive fire protection guidance published by the ASFP should be referred to. The ASFP promotes third party certification of materials in products and systems from their manufacturing members as Principle T, and third party certification of the works from their installer members as Principle U. The ASFP stresses the importance of a commitment to maintenance as Principle Y.

https://asfp.org.uk/

10.21 Principle U – Require Competent Work

Principle U – Require Competent Work

Confirm protection measures are installed by identified specialists, trained and supervised under third party quality of work schemes accredited by the United Kingdom Accreditation Service, with full disclosure of fire safety information.

U.1 Satisfy Regulation 7(1)(b) of the Building Regulations 2010

U.2 Identified operatives are third party certified under a quality of work scheme

U.3 Schemes are accredited by the United Kingdom Accreditation Service (UKAS)

U.4 Understand the technical meaning of all test reports and assessments

U.5 Check the suitability of substrates with any formed openings and cavities

U.6 Maintenance contracts with original installers to encourage better service

U.7 Comprehensive automatic fire alarm system with high-integrity detectors

U.8 Fire Safety Information for Regulation 38 in the Building Regulations 2010

Regulation 7

Quality of work shall satisfy the requirements of Regulation 7(1)(b) of the Building Regulations 2010, as amended 2018 and 2022, as BDM01-12.

Quality of work

The accreditation overview of United Kingdom Accreditation Service (UKAS) was discussed as Principle S. Choice of UKAS accredited third party quality of work schemes under the contract is therefore important. Quality of work is not the primary remit of the Construction Products Association (CPA) as Principle T.

Early guidance from insurers on the most appropriate third party quality of work schemes for contractors should be obtained by the client among their consultations as Principle B.

It falls to the client to require the works to be undertaken through those schemes, in specifications incorporated into the contract by their appointed consultants. All too often in the past, contractors objected to such contract conditions at tender stage, but that is precisely the moment to insist upon third party schemes to protect the investment.

Absence of schemes

It is also important to identify where appropriate UKAS accredited third party quality of work schemes do not exist. There are several self-certification schemes that provide exemptions under Regulation 12(6) of the Building Regulations 2010, as amended, but not all of these schemes are UKAS accredited.

Regulation 12(6)

Regulation 12(6) of the Building Regulations 2010, as amended, identifies where a person intending to carry out building work is not required to give a building notice or deposit full plans.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/12

Self-certified work

Regulations 12(6)(a) and 20(1) apply where the work consists only of a category described in Schedule 3 of the Building Regulations 2010, as amended, which identifies the self-certification schemes that apply to the work category.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/3

https://www.legislation.gov.uk/uksi/2010/2214/regulation/20

However, Schedule 1 of the Building Regulations &c. (Amendment) Regulations 2015 seems to have overwritten Schedule 3 of the Building Regulations 2010 with a different listing. The legislation website is not updated. The self-certification schemes address the installation of the following categories of work, with their associated control systems:

https://www.legislation.gov.uk/uksi/2015/767/schedule/1/made

1 Heat-producing gas appliances

2 Oil-fired combustion appliances, oil storage tanks and connecting pipes

3 Solid fuel-burning combustion appliances other than biomass appliances

4 Heating or hot water systems

5 Mechanical ventilation or air conditioning systems in buildings other than dwellings

6 Mechanical ventilation or air conditioning systems in dwellings

7 Energy efficient lighting systems or electric heating systems in buildings other dwellings

8 Fixed low or extra-low voltage electrical installations in dwellings

9 As 8, but as a necessary adjunct to or arising out of other work categories

10 Replacement windows, roof lights, roof windows or doors in existing dwellings

11 Replacement of windows, roof lights, roof windows or doors in an existing building other than a dwelling, not including load bearing or structural glass, non-loadbearing curtain walling, or a revolving door

12 Sanitary conveniences, sinks, washbasins, bidets, fixed baths, showers or bathrooms in dwellings not involving shared or underground drainage

13 Supply of wholesome or potable cold water or softened cold water supply

14 Supply of non-wholesome or non-potable water to sanitary conveniences fitted with a flushing device not involving shared or underground drainage

15 Microgeneration or renewable energy source systems producing electricity, heating or cooling, including solar panels

16 Replacement of pitched or flat roof coverings and work carried out by the registered person as a necessary adjunct to roofing works, including thermal insulation, but excluding systems as 15

17 Insulation inserted into the external cavity walls of an existing building

18 Insulation to internal faces of external walls of an existing building, not including flexible thermal linings

19 Insulation to external walls of an existing building, not including demountable-clad buildings

20 Insulation as "hybrid insulation" combining 18 internally and 19 externally

Dry insulation

The selection of non-combustible or combustible thermal insulation is discussed as Principle D. Prospects of water damage are considered in Principles M and N. The decision to thermally upgrade an existing building envelope in categories 16 to 20 requires consideration of why any external air cavity was initially constructed, and hygrothermal performance as BDM01-16 (E-AD-C).

Repeated wetting and drying, freezing and thawing of the building fabric can cause problems such as damp, condensation, mould growth, and loss of thermal performance, which may result in premature failure.

Competent persons

The self-certification schemes approved by the Ministry for these categories of works change more quickly than the legislation seems able to account for. New categories may be added. The competent person schemes recognised by government appear to be updated online. The suitability of current schemes shall be checked.

https://www.gov.uk/guidance/competent-person-scheme-current-schemes-and-how-schemes-are-authorised#current-schemes

The Ministry, initially as MHCLG but now as DLUHC, set the minimum competence requirements for organisations and individuals in a competent person scheme.

https://www.gov.uk/government/publications/competent-person-scheme-minimum-technical-competence-requirements

Gas appliances

The Gas Safety (Installation and Use) Regulations 1998 apply in England, Scotland, and Wales, as amended by the Gas Safety (Installation and Use) (Amendment) Regulations 2018, though the 2018 amendments are not incorporated online.

https://www.legislation.gov.uk/uksi/1998/2451/contents/made

https://www.legislation.gov.uk/uksi/2018/139/made

The Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004 apply.

https://www.legislation.gov.uk/nisr/2004/63/contents/made

Gas Safe Register

Category 1 self-certified works installing heat-producing gas appliances and their associated controls require all gas service businesses and their engineers to be on the Gas Safe Register (GSR). The GSR is not a competent person scheme because it is a register. However, it is listed among the government recognised competent person schemes. Anyone undertaking gas work in the UK not Gas Safe registered may be working illegally and should be reported.

https://www.gassaferegister.co.uk/gas-safety/concerns-reporting-illegal-gas-work/

https://www.gassaferegister.co.uk/media/1600/rules-of-registration.pdf

https://www.gassaferegister.co.uk/media/1421/gas-safe-register-registration-policy.pdf

Gas is odourless. However, the addition of Methanethiol known as "Mercaptan" with a sulphurous, non-toxic, and harmless artificial smell like rotten eggs, helps to enable detection. Where a gas leak is suspected, it should be reported and the gas emergency services called on a free 24-hour National Gas Emergency Helpline.

https://www.gassaferegister.co.uk/gas-emergency/what-to-do-in-a-gas-emergency/

Third Party certified

Regulations 12(6)(c) and Regulation 20A apply where the building work consists only of a category described in Schedule 3A of the Building Regulations 2010, as amended, to be inspected by a third party certifier.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/3A

https://www.legislation.gov.uk/uksi/2010/2214/regulation/20A

NAPIT electrical

There is one third party certified scheme that is listed in Schedule 3A. The National Association of Professional Inspectors and Testers (NAPIT) is government approved and UKAS accredited for electrical installations in dwellings.

https://www.napit.org.uk/schemes/third-party-certification.aspx

The certifier completes an Electrical Installation Report (EIR) and submits to NAPIT within 21 days of the date of the final inspection. The EIR is audited by NAPIT before the work is certified as compliant with Building Regulations.

https://www.napit.org.uk/downloads/TPC-process-for-notifications.pdf

Stroma electrical

A further third party certification scheme for domestic electrical work introduced Stroma. This notice was accompanied by *Minimum technical competence for third party certification schemes for electrical installations in dwellings*.

https://www.gov.uk/guidance/third-party-certification-schemes-for-domestic-electrical-work

For the three categories of electrical work, 7, 8 and 9, the schemes last updated on 12 March 2018 are:

9	Association of Plumbing and Heating Contractors (APHC)
7,8,9	Building Engineering Services Competent Assessment (BESCA)
7,8,9	Blue Flame Certification
7,8,9	National Inspection Council for Electrical Installation Contracting (NICEIC)
7,8,9	National Association of Professional Inspectors and Testers (NAPIT)
8	Oil Firing Technical Association (OFTEC)
7,8,9	Stroma

Electrical mark

All operatives undertaking electrical work after 2014, regardless of the other building services categories they install, shall be able to demonstrate their registration with the Registered Competent Person Electrical mark.

https://www.electricalcompetentperson.co.uk/About-Us

Electrical work

Since 2005, all electrical work in dwellings in England shall meet the requirements of Part P of Schedule 1 of the Building Regulations 2010, as BDM01-11. In England, these requirements are given practical meaning in BDM01-16 (E-AD-P).

https://www.electricalcompetentperson.co.uk/Building-Regulations-Explained

Electricians with the Registered Competent Person Electrical mark will be able to self-certify their work to assure it complies with the British Standard for electrical safety BS 7671:2018+A2:2022 *Requirements for Electrical Installations. IET Wiring Regulations*.

Sprinkler work

Loss Prevention Standard LPS 1048: Issue 5.0 *Requirements for the approval of sprinkler system contractors in the UK and Ireland* shall be referred to.

https://www.redbooklive.com/download/pdf/LPS-1048-Requirements-for-the-approval-of-sprinkler-system-contractors-in-the-UK-and-Ireland.pdf

BAFSA

Sprinkler system design, fabrication, and installation work shall be undertaken by accredited members of the British Automatic Fire Sprinkler Association (BAFSA), to be serviced and maintained as Principle Y.1, as BDM01-10.25. BAFSA publish a series of Information Files, some addressing Purpose Groups as Principle G.

https://www.bafsa.org.uk/

https://www.bafsa.org.uk/bafsa-publications/bifs/

For quality of work reference shall be made to BIF 24 *Training and Qualifications in the Sprinkler Industry* – May 2020.

https://www.bafsa.org.uk/wp-content/uploads/bsk-pdf-manager/2020/05/BIF24_may2020.pdf

BIF 26 *Sprinklers and the Insurance Industry* – February 2015 provides some background to the importance of sprinklers as Principle I to insurers consulted as Principle B. BIF 26 also provides an indicative checklist for sprinkler inspection.

https://www.bafsa.org.uk/wp-content/uploads/bsk-pdf-manager/2017/06/BIF-26-Sprinklers-and-the-Insurance-Industry.pdf

BAFE

Originally established as the British Approvals for Fire Equipment (BAFE), the company has developed into a register of quality fire safety service providers in the UK, assessed through UKAS accredited Certification Bodies.

www.bafe.org.uk/

Through their campaign *Don't Just Specify, Verify!* BAFE advise verifying third party certification is appropriate for the work specified before awarding any contract. BAFE registration, or any third-party certification, does not determine evidence of competency for all fire safety services. Specialist consultants and contractors may have third party certification for multiple services and may offer services that are not third party certified. Each service offered will have undergone independent assessment of the specialist's competency for that specific area. UKAS accredited third-party certification is always for a specific service.

https://www.bafe.org.uk/bafe-fire-safety-guidance/dont-just-specify-verify-third-party-certification

BAFE manage and maintain the BAFE SP203-1 scheme for detection and alarm systems. This scheme exists to deliver quality, independent evidence that providers are competent to design, install, commission, and maintain detection and alarm systems, as Principle R.

https://www.bafe.org.uk/bafe-fire-safety-services/fire-detection-and-fire-alarm-systems

NSI and BAFE

The National Security Inspectorate (NSI) operates all of the major BAFE schemes including SP203-1. The coverage of schemes is increasing.

https://www.bafe.org.uk/nsi-national-security-inspectorate

https://www.nsi.org.uk/about-nsi/

SHEV scheme

Smoke and Heat Ventilation (SHEV) systems shall be procured on the basis of IFCC SDI 19 *Installer Certification Scheme – Requirements for Specialist Contractors Designing and Installing Smoke Control Systems.*

http://www.ifccertification.com/certification/installer-certification.html

An uncontrolled copy of IFCC SDI 19 Version 1.3, dated 14 April 2020, is available from the Smoke Control Association (SCA) here:

https://www.smokecontrol.org.uk/client/files/SDI_19_V1_3_Scheme_for_Installers_of_Smoke_Control_Systems_Uncontrolled_1404201.pdf

The BS EN 12101 series for smoke and heat control systems has several Parts:

- Part 1 Specification for smoke barriers
- Part 2 Specification for natural smoke and heat exhaust ventilators
- Part 3 Specification for powered smoke and heat exhaust ventilators
- Part 6 Specification for pressure differential systems. Kits
- Part 7 Smoke duct sections
- Part 8 Smoke control dampers
- Part 10 Power supplies
- Part 13 Pressure Differential Systems (PDS)

Fire Door schemes

Fire Door schemes are important for investors to select and insist upon exclusively and universally in the building. They include but are not limited to:

- Fire Door Alliance (FDA), as probably the best known, operated by the British Woodworking Federation (BWF)
  https://firedoors.bwf.org.uk/be-certain-be-certified/
- Timber Trade Federation (TTF), part of Timber Development UK (TDUK)
  https://ttf.co.uk/courses/timber-trade-topics/fire-doors/
- International Fire Consultants (IFC)
  www.ifccertification.com/certification/installer-certification.html

Service penetrations

The supporting notes BDM01-10.6 for Principle F, BDM01-10.9 for Principle I, and BDM01-10.20 for Principle T referred to the collaborative *Firestopping of service penetrations – best practice in design and installation*.

https://www.thebesa.com/technical/publications-knowledge/fire-stopping-of-service-penetrations/

The collaborating trade associations were:

- Association for Specialist Fire Protection (ASFP)
  https://asfp.org.uk/
- Building Engineering Services Association (BESA)
  https://www.thebesa.com/
- Building Services Research and Information Association (BSRIA)
  https://www.bsria.com/uk/
- Finishes and Interiors Sector (FIS)
  https://www.thefis.org/
- Gypsum Products Development Association (GPDA)
  https://gpda.com/

All these trade associations promote third party certification of work and management by their installer members. This effort is all working towards achieving Principle V in the Regulation 38 Fire Safety Information exchange.

Conformity

Conformity Assessment Bodies (CABs) are accredited by UKAS to BS EN ISO/IEC 17065:2012 *Conformity assessment. Requirements for bodies certifying products, processes and services*. They include, but are not limited to:

- FIRAS – a third party certification scheme for installation contractors of both passive and active fire protection systems, operated by Warringtonfire
  https://www.warringtonfire.com/certification-services/fire-certification/firas
- Loss Prevention Certification Board (LPCB) – provides third-party certification to confirm that products and services have met, and will continue to meet, the Loss Prevention Standards (LPS) favoured by insurers, operated by BRE
  https://bregroup.com/products/lpcb/
- Security Systems and Alarms Inspection Board (SSAIB) – a certification body for organisations providing security systems and services, fire detection and alarm systems, telecare systems and services, manned security services and monitoring services. SSAIB is a certification body for the Security Industry Authority (SIA) Approved Contractors Scheme in the UK and Ireland.
  https://ssaib.org/page/about-ssaib/
  https://www.gov.uk/government/organisations/security-industry-authority

Sub-contractors

Specialist fire protection installers depend upon the programme and quality of work from preceding or following sub-contractors, who may have more commercial leverage with the "Principal Contractor". The blockwork or dry lining sub-contracts and the Mechanical, Electrical and Plumbing (MEP) building services sub-contracts will be of higher value than specialist fire protection works.

Minor specialist fire protection sub-contractors often struggle to reject unsuitable substrates and openings, but they must be assisted to a position where they can insist upon a quality of the preceding works, and the protection of their work, in the programme to Work Stage 6 handover.

The specification and procurement of fire doors in frames, or preferably complete doorsets, is addressed as Principle T. The sub-contracts for Joinery will be of higher value than specialist fire protection works associated with it, which may be undertaken as a sub-sub-contract.

The correct installation of those fire doors in frames or doorsets with their as-tested tolerances, fixing and fire stopping into prepared openings, fitting and adjustment of seals, ironmongery and self-closing devices is of critical importance as an aspect of Principle U. After installation, maintenance as Principle Y should be addressed through assessment as Principle X as an aspect of fire safety management as Principle W.

PAS 8670 series

The BSI was concerned with "... a fragmented approach to – and a lack of consistency in – the processes and standards for assuring the competence of those working on buildings".

https://www.bsigroup.com/en-GB/industries-and-sectors/construction-and-the-built-environment/built-environment-competence-standards/

The publication of BSI Flex 8670: v3.0 2021-04 *Built environment – Core criteria for building safety in competence frameworks – Code of practice* allows ease of update to the code of practice. The latest revision should be looked for.

https://www.bsigroup.com/en-GB/industries-and-sectors/construction-and-the-built-environment/built-environment-competence-standards/download-form/

The series currently addresses the competence of "Principal Designers", "Principal Contractors", and safety managers of residential buildings:

- PAS 8671:2022 *Built environment – Framework for competence of individual Principal Designers – Specification*
  https://www.bsigroup.com/en-GB/industries-and-sectors/construction-and-the-built-environment/built-environment-competence-standards/pas-8671/
- PAS 8672:2022 *Built environment – Framework for competence of individual Principal Contractors – Specification*
  https://www.bsigroup.com/en-GB/industries-and-sectors/construction-and-the-built-environment/built-environment-competence-standards/pas-8672/
- *PAS 8673:2022 Built environment – Competence requirements for the management of safety in residential buildings – Specification*
  https://www.bsigroup.com/en-GB/industries-and-sectors/construction-and-the-built-environment/built-environment-competence-standards/pas-8673/

10.22 Principle V – Verify Recorded Information

Principle V – Verify Recorded Information

Accept only pertinent and accurate information at handover, insisting contractors satisfy statutory and contractual duties, checking record information provides full disclosure of the premises as built and commissioned for facilities management.

V.1 Design and construction is reviewed against the Resilience Strategy

V.2 Demonstrate the smoke control system to the Fire and Rescue Service

V.3 Schedule of primary, secondary, and tertiary components for maintenance

V.4 Concealed secondary or tertiary components accessible for maintenance

V.5 Photographic record of installation of inaccessible but critical components

V.6 Final Movements and Tolerances Report verified in a single collated survey

V.7 Residual CDM 2015 Health and Safety file from the "Principal Contractor"

V.8 Full disclosure of failure to satisfy Evacuation, Fire, and Resilience Strategies

V.9 Realisation of Evacuation, Fire, and Resilience Strategies in Work Stage 5

V.10 "Responsible Person" informed of unresolved discussions and agreements

V.11 Fire Safety Information is focused and distinct from the Building Manual

V.12 Regulation 38 Fire Safety Information is signed and dated for handover

V.13 Fire Safety Information and Building Manual available to insurers on request

V.14 Verify compliance with the Employer's Requirements and Resilience Strategy

V.15 Handover is prepared for by the "Principal Contractor" under contract

Practical completion

Handover of the works occurs in Work Stage 6, when the building is practically complete under contract. Outstanding works, some of which will be identified as patent defects, are to be addressed in a contracted period of time by the "Principal Contractor". The moment of handover does not mean the building is fully complete, though the works must be completed sufficiently. The Building Safety Act 2022 is strengthening the Latent Damage Act 1986.

https://www.legislation.gov.uk/ukpga/1986/37

https://blogs.law.ox.ac.uk/blog-post/2022/07/limitation-periods-contract-and-tort-how-much-time-there-bring-claim

https://blogs.law.ox.ac.uk/blog-post/2022/07/building-safety-act-2022-extending-limitation-periods-creating-new-possibilities

The contracting parties would be wise to define "Practical Completion" in the contract. The BDM01 checklist of actions may be a prompt at tender.

Outstanding works

It would be unwise for the investor, acting either as or through the client, to accept the building as practically complete if outstanding works mean the building is unsafe to be occupied, unless the clear intention under contract is to delay occupation until the "Principal Contractor" completes the outstanding works required for safe occupation. It is a matter of contractual negotiation, if not dispute, if there is a delay in occupation after handover as Work Stage 6.

Resilience Strategy

Only with a Resilience Strategy will the Regulation 38 Fire Safety Information exchange be about more than health and life safety, as important as that is. Fire Safety Information exchange valued by investors and insurers has to start in a Resilience Strategy to give meaning to Strategy, Testing, Inspection, Certification, and Compliance (STICC), discussed as Principle S in BDM01-10.19.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/38

Principle V.9 highlights that Evacuation, Fire, and Resilience Strategies need to be realised before the end of Work Stage 5, while Principle V.14 encourages the investor to verify the works before handover at Work Stage 6.

Principle V.9

Realisation of the Evacuation, Fire, and Resilience Strategies is verified through the draft Regulation 38 Fire Safety Information exchange and confirmed by the natural person appointed by the client as Principle A, or by the "Responsible Person" if available as the legal duty holder, before the end of Work Stage 5.

Principle V.14

Compliance of the building works with the Employer's Requirements or contract documents, including but not limited to the Resilience Strategy, is verified by the investors acting either as or through the client and their consultants before handover at Work Stage 6, with expectations as agreed in the contract.

Handover response

The handover response from the "Principal Contractor" to draw Work Stage 6 to the contract moment of "Practical Completion" shall include but is not limited to:

- Project Brief
- Resilience Strategy
- Fire Strategy based on Evacuation Strategy
- Planning Approval and Reserved Matters Schedule closures
- Movements and Tolerances Report for non-fire and fire situations
- Construction Service Life Planning to BS ISO 15686 and Maintenance Strategy
- CDM 2015 Health and Safety File from the "Principal Contractor"
- Records of Strategy, Testing, Inspection, Certification, and Compliance (STICC)
- Specification and Submittal list with full disclosure of all submittals made
- Photographic evidence of critical concealed construction works as contracted
- Third Party certifications for quality of materials and work under Regulation 7
- Defects list to be resolved in the Defects Liability Period after handover
- Regulation 38 Fire Safety Information signed by the "Responsible Person"
- Building Manual including the Soft Landing for building services
- Building control approval with Fire and Rescue Service assent
- Handover Fire Risk Assessment

Building Manual

The Building Manual is provided at handover under contract to explain the building arrangement and construction to the client's facilities manager. This is often referred to as an "Operations and Maintenance Manual" or "O&M Manual". It is not a statutory requirement, but a deliverable to be specified in the contract that relates directly to the property as an asset.

Separation

The separation of a high quality Building Manual from an enhanced Regulation 38 Fire Safety Information exchange is important. The information provided in a Building Manual is often voluminous, can be a mixture of printed and digital formats, and may be badly organised, deficient, incorrect, or irrelevant to the needs of the facilities manager of the specific building.

Fire Safety Information is not meant to be dispersed through a rambling Building Manual, and Regulation 38 is a separate exercise in communication.

Preparation

Dumped on an unprepared client, a low quality Building Manual will be neglected by the facilities manager, or even lost. A high quality Building Manual insisted upon by the prepared client, delivered with training for the facilities manager before handover, is likely to be valued and updated over time to keep it current.

Collaboration

The supporting notes BDM01-10.6 for Principle F, BDM01-10.9 for Principle I, BDM01-10.20 for Principle T, and BDM01-10.21 for Principle U all referred to the collaborative *Firestopping of service penetrations – best practice in design and installation*. This is essential reading for Principle V.

https://www.thebesa.com/technical/publications-knowledge/fire-stopping-of-service-penetrations/

Regulation 4

Both Volumes of BDM01-16 (E-AD-B) provide the same summary of the convoluted phrasing of Regulation 4 in the Building Regulations 2010, as amended. The statutory guidance states building work should be carried out in such a way that, when work is complete:

a. For new buildings or work on a building that complied with the applicable requirements of the Building Regulations: the building complies with the applicable requirements of the Building Regulations.

b. For work on an existing building that did not comply with the applicable requirements of the Building Regulations:

   i. the work itself must comply with the applicable requirements of the Building Regulations, and

   ii. the building must be no more unsatisfactory in relation to the requirements than before the work was carried out.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/4

Regulation 16B

The Building and Approved Inspectors (Amendment) (No. 2) Regulations 2006 amended the Building Regulations 2000 with Regulation 16B, expecting fire safety information to be provided at handover. The Building Regulations 2000 had undergone a series of amendments but the Regulation 16B amendment was obscurely included in a second amendment in 2006. Regulation 16B was the precursor to Regulation 38 in the Building Regulations 2010, but widely ignored.

https://www.legislation.gov.uk/uksi/2000/2531/contents/made

https://www.legislation.gov.uk/uksi/2000/2532/contents/made

https://www.legislation.gov.uk/uksi/2006/3318/made

Regulation 38

After 2006, Regulation 16B became the more prominent Regulation 38 Fire Safety Information in the Building Regulations 2010.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/38

BDM01-8

Early appointment of the "Responsible Person" is discussed as BDM01-8.

https://www.legislation.gov.uk/uksi/2005/1541/article/3/made

"Responsible Person"

The earliest possible appointment of the "Responsible Person" in the *RIBA Plan of Work 2020* enables them to better define the scope and sufficiency of the statutory Fire Safety Information exchange required by Regulation 38. They will relieve the natural person

appointed by the client as Principle A. They may do this during the construction or design phases. The earlier the better.

The "Responsible Person" may be a different appointment to obtain design, construction or facilities management expertise.

Early appointment

Active involvement of the "Responsible Person" is expected no later than the commencement of Work Stage 6 handover. There is no obstacle to earlier appointment of the "Responsible Person" in the 2005 Regulatory Reform (Fire Safety) Order, and their involvement in construction and design will assist the "Principal Contractor" and, if early enough, the "Principal Designer".

HSE L153

The HSE publication L153 *Managing health and safety in construction – Guidance on Regulations*, published in 2015, shall be complied with by the "Principal Designer" and "Principal Contractor".

www.hse.gov.uk/pubns/priced/l153.pdf

HSE HSG 168

Referred to in Principle B and related to the *JCoP on Fire Prevention on Construction Sites* 2022, HSE HSG 168 *Fire safety in construction* – Third Edition was published in July 2022. The guidance "... explains how everyone involved in construction projects can comply with their legal duties relating to fire risks. It is aimed at all those who procure, design, develop and manage construction sites, including clients and designers. It is relevant to all construction projects."

https://www.hse.gov.uk/pubns/books/hsg168.htm

The main changes to HSE HSG 168 2022 relate to the elimination and reduction of fire risks at the pre-construction stage, as required by the Construction (Design and Management) Regulations 2015. That is prior to Work Stage 5.

SFARP

The principle of "so far as reasonably practicable" shall not be used as an excuse for poor architectural design. The impracticality of inspection should not be designed into a building. Inspection of cavity barriers and fire stopping is often practically difficult. There is a further complication that the location of those inspections which are achievable may not be representative of the variations in construction on the building as a whole.

Accessibility

The extent of cavity barriers and fire stopping that needs to be inspected and may require replacement should be safely accessible without destructive works. This may require more than localised Access Panels through fire resisting or non-fire resisting construction. Positioning of Furniture, Fixtures and Equipment (FF&E) should not frustrate access.

Inaccessibility

Where cavity barriers and fire stopping are intended to be inaccessible, an as-built photographic survey record should be obtained during site installation before these critical interface details are covered by subsequent construction. It will be impossible to verify inaccessible cavity barriers and fire stopping after Work Stage 5. The photographic evidence should be acquired before works are covered and cannot be reviewed.

Following works

The "Principal Contractor" should not encourage or allow their sub-contractors to cover preceding works that are critical to fire safety before photographic records are made. With digital technologies, such photography has never been easier. The purposeful record taking should be an aspect of the budget and programme of works that has been tendered and contracted.

"Sign off"

In Work Stage 5, the "Principal Contractor" should establish a procedure of formal fire safety "sign-off" by the "Responsible Person" appointed early by the client, in advance of Work Stage 6 handover. That initiative is also in the client's interest under the contract, to avoid compromising the achievement of Principles W, X and Y, whether the client is intending to use, rent or sell the property.

Defining information

Often, the complaint by clients, consultants, and contractors alike is that no definition of a Regulation 38 Fire Safety Information exchange is provided. This is a thin excuse for making no effort to satisfy the legal requirement of Regulation 38, which was far more obvious than its precursor, Regulation 16B.

Currently, both Volumes of BDM01-16 (E-AD-B) further assist in:

- Section 17 of (E-AD-Bv1)
- Section 19 of (E-AD-Bv2)

Templates

RISCAuthority is proposing to develop a number of Regulation 38 Templates by Purpose Group to support the improvement of BDM01 over time. Purpose Groups will align with BDM02 as the core document.

Soft Landing

The idea of "Soft Landings" at handover has been well established in the building services sector, and is discussed further in Principle F. Soft Landing requires a building delivery approach that runs through the project Work Stages. The BSRIA Soft Landings Network was established in 2010 to support understanding of this process, promote its uptake across the industry, and ensure its continuous development.

https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/user-group/

https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/guides/

FRA and FRAEW

Without a Regulation 38 Fire Safety Information exchange, it is unreasonable to expect any veracity to the first Fire Risk Assessment (FRA) or the associated Fire Risk Appraisal of External Walls (FRAEW) that precede occupation as Principle X.

10.23 Principle W – Manage Fire Safety

Principle W – Manage Fire Safety

Provide fire safety management services to the satisfaction of the statutory duty holders appointed by the building owner and, if different, the building operator, including induction and training in fire safety for building users on the premises.

W.1 Training in duties imposed by Regulatory Reform (Fire Safety) Order 2005

W.2 Residual matters in the CDM 2015 Health and Safety File resolved

W.3 Copy of the Building Manual for operational and maintenance information

W.4 Components replaced where degraded more rapidly than expected

W.5 Waterproofing and drainage reinstated when modifications are undertaken

W.6 Green roofs and walls maintained under professional contract as Principle Y

W.7 Conditions on building contents related to use are imposed and enforced

W.8 Moveable heating and ventilation appliances controlled in their use

W.9 Personal Emergency Evacuation Plans (PEEPs) are established and practised

W.10 Building owner or operator meets new building users and provides training

W.11 Practise "fire drills" and improve the Evacuation Strategy following the alarm

W.12 Construction re-assessed as Principle X and maintained as Principle Y

W.13 Accessibility unaffected by Furniture, Fixtures and Equipment (FF&E)

W.14 Combustible contents as an occupational fire load not exceeded by users

W.15 Review fire safety measures and procedures for insurance policies

W.16 Record of FRAs and FRAEWs made available to insurers on request

Insurance cover

Insurance availability and terms may be linked to the maintenance of an adequate standard of fire safety management, by which conditions of use are enforced on the premises, whether they are imposed through statute, the established Evacuation, Fire, or Resilience Strategies, or by insurance policies. Appointment of the "Responsible Person" supports the fire safety management regime.

Capable managers

Fire safety management is an important aspect of the Evacuation, Fire, and Resilience Strategies that need to be anticipated by investors acting either as or through clients as Principle A. Many of the actions that follow from decisions made during early consultations with insurers, as Principle B, or the Fire and Rescue Service, as Principle C, will be undertaken by capable fire safety managers.

Record keeping

Building owners or operators should maintain documented fire safety management procedures and demonstrate they are being complied with on a continuing basis.

BS 7974

The Resilience Strategy involves, but is more than, fire engineering, even when a Chartered Fire Engineer is instructed to guide other consultants through BDM01-16 (E-AD-B). In a fire engineered building, the appropriate frequency and depth of life safety and property protection fire risk assessments must be described in the fire engineering. The fire engineering approach to a higher quality of Fire Strategy containing an Evacuation Strategy is formalised in BS 7974:2019 *Application of fire safety engineering principles to the design of buildings*.

www.bsigroup.com/globalassets/localfiles/en-gb/built-environment/bs-7974-fire-safety-brochure-web.pdf?id=431352

BS 9997

Reference by the fire safety management shall be made to BS 9997:2019 *Fire risk management systems. Requirements with guidance for use*. The mandatory FRA and any further requirement for a FRAEW for health and life safety as Principle X must be enhanced to include assessment for the Resilience Strategy as Principle A.

Universal escape

The Health and Safety at Work etc Act 1974, the Disability Discrimination Act 1995, and the Management of Health and Safety at Work Regulations 1999 require employers to implement effective arrangements for emergency evacuation for all employees. The Regulatory Reform (Fire Safety) Order 2005 requires building owners and operators to ensure that all people can leave the building they control safely in the event of a fire. This universality was not changed by the Fire Safety Act 2021, which was a clarification of the earlier health and life safety legislation.

https://www.legislation.gov.uk/ukpga/1974/37/contents

https://www.legislation.gov.uk/ukpga/1995/50/contents

https://www.legislation.gov.uk/uksi/1999/3242/contents

https://www.legislation.gov.uk/uksi/2005/1541/contents

https://www.legislation.gov.uk/ukpga/2021/24/contents

Management focus

Following consultation with the Fire and Rescue Service as Principle B, attention shall be given to the following:

Equipment selected and located in Work Stage 4

- Emergency Lighting and illuminated Fire Signage as Principle F.14
- Fixed non-illuminated Signage
- Evacuation Alert System (EAS) where "Stay Put" applies as BDM01-10.18
- Premises Information Box (PIB) in all buildings other than Dwellinghouses
- Fire Extinguishers and Blankets for immediate use on very small fires

Training prepared for in Work Stage 6

- Fire awareness and prevention training including the importance of escape
- Evacuation Strategy practised as a "fire drill" on activation of the fire alarm

PEEPs

Personal Emergency Evacuation Plans (PEEPs) are considered as Principles C and X, as part of the Evacuation Strategy. They are a personalised aspect of the knowledge the fire safety management must make practical sense of.

Labelling Scheme

The Association for Specialist Fire Protection (ASFP), the Finishes and Interiors Sector (FIS), and the Gypsum Products Development Association (GPDA) recognise that Fire safety management has to be maintained while the mechanical and electrical building services are changed over time. They understand that:

"One of the biggest issues facing M&E contractors who are employed to pass services through a building, is that they may not be aware that the partitions they need to pass through are fire rated, and any holes cut into them will negate the performance of the partition."

For walls and floors that have fire resistance as part of the compartmentation, as Principle I, a Fire Performance Labelling Scheme (FPLS) has been developed as a partnership between ASFP, FIS and GDPA. This is based on a "quick response" or QR code, as a 2D matrix barcode, to be read with a mobile phone App. It is recommended to assist contractors, the fire safety management, and the "Responsible Person", as part of the task of maintaining Building Manuals.

https://www.thefis.org/knowledge-hub/technical/fire-protection/firestopping/fire-labelling/

Building Manuals

The opportunities for labelling the building with QR code links to the Building Manual are an advance on the earlier attempt in the 2000s to use Radio-Frequency Identification (RFID) in construction products and systems.

The development of digital information management is advancing at incredible pace with great ingenuity. Computer Aided Design (CAD) has been developed into Building Information Modelling (BIM), which can be fed back to the grades of building staff, their various contractors, or even general users, as Augmented Reality (AR). The advancing techniques available to members of The Survey Association (TSA) show the ways a digital Building Manual handed over at Work Staged 6 can be updated throughout Work Stage 7. If managed well.

https://www.tsa-uk.org.uk/

While the age of an analogue Building Manual as a shelf of printed files is over, the task of maintaining the content of the digital Building Manual remains a laborious commitment by knowledgeable employees. It is naïve to imagine otherwise. The best digital Building Manual could rapidly become disconnected from incremental real world changes in the built asset, particularly in the building services, with consequences for fire safety management. Understanding takes time and effort.

Controllable risks

Candles for light, open fires for heating, and smoking indoors are increasingly a thing of the past in many building Purpose Groups, though they can survive in domestic life. Meanwhile, ignition risks remain and require monitoring in building services, as Principle F. These are located alongside the storage of combustible and even volatile materials, among the Furniture, Fixtures and Equipment (FF&E), and the ordinary contents changed by occupants.

New technologies, such as Building Integrated Photovoltaic (BIPV) panels, extend the scope of building services, and create novel risks, requiring disposal after a service life. The ubiquity of Information Technologies (IT) among the many rechargeable devices people carry and plug in present challenges. Disposable battery disposal is becoming a concern at recycling centres. This is being invested in as "urban mining", and extends into generations of new vehicles.

https://www.veolia.co.uk/press-releases/veolia-announces-its-first-electric-vehicle-battery-recycling-plant-uk

Many of these developments are addressed by RISCAuthority and the FPA in the Risk Control (RC) series of publications, as a frontier of knowledge. For example the risk of lithium-ion battery fires was addressed in:

- RISCAuthority RC59 *Recommendations for fire safety when charging electric vehicles* Version 1 - 2021
  https://www.thefpa.co.uk/resource-download/360
- RISCAuthority RC61 *Recommendations for the storage, handling and use of batteries* Version 1 – 2014
  https://www.thefpa.co.uk/resource-download/362

The RC series is being updated, while the developing RE series of "Need to Know Guides" may provide a distillation of information superseding some RC titles, as Principle F.12, discussed in BDM01-10.6. Mobile devices require management as Principle X.5, discussed as BDM01-24. This is important for facilities managers as mobile lithium-ion batteries and the infrastructure for battery charging is proliferated as a matter of policy. Including planning policy.

Lithium-ion batteries

The market for electric vehicles has increased with technological advance, but the risk of lithium-ion battery fires, their severity, and the near impossibility of extinguishing the thermal runaway event that generates oxygen in the chemical reaction mean that further

guidance is needed. Consultation with the Fire and Rescue Service as principle B may result in little practical resolution.

This is of course not only relevant for Car Parks or those storing fleets of electric vehicles. Individual parked vehicles, or those small enough to be dangerously brought indoors and charged overnight, are causing severe fire events. Such vehicles are sensibly banned from transport infrastructure. The infrastructure needed has resulted in an extension of Schedule 1 Requirements of the Building Regulations 2010, as BDM01-11, and statutory guidance:

(E-AD-S)

Approved Document S: Infrastructure for charging electric vehicles

(2021)

https://www.gov.uk/government/publications/infrastructure-for-charging-electric-vehicles-approved-document-s

Hydrogen services

As hydrogen is increasingly used as an energy storage medium, piped into buildings as a gas supply, and used for reverse electrolysis in fuel cells, there may be risks for general facilities managers, more specialist fire safety managers, and the duty holding "Responsible Person" to consider, as Principle F.9.

10.24 Principle X – Action Statutory Assessments

Principle X – Action Statutory Assessments

Instruct, review, and promptly act upon Fire Risk Assessments that consider the scale or complexity of the building and the activities undertaken by building users on the premises, keeping a written record of assessments and actions over time.

X.1 The "Responsible Person" has carried out and reviewed FRAs and FRAEWs

X.2 Matters arising from the FRAs and FRAEWs are promptly actioned

X.3 All building services access panels with fire resistance are kept locked

X.4 Moveable heating and ventilation appliances addressed in the FRA period

X.5 Moveable equipment with lithium-ion batteries addressed in the FRA period

RR(FS)O 2005

The "Responsible Person" is the duty holder who, under the Regulatory Reform (Fire Safety) Order 2005, is required to:

- carry out a fire risk assessment of the premises and review it regularly;
- tell staff or their representatives about the risks you've identified;
- put in place, and maintain, appropriate fire safety measures;
- plan for an emergency; and
- provide staff information, fire safety instruction and training.

https://www.gov.uk/workplace-fire-safety-your-responsibilities

https://www.legislation.gov.uk/uksi/2005/1541/contents

A difficulty with the RR(FS)O 2005 is that it is framed in terms of "Staff", rather than "Residents". One of the attitudinal shifts that has followed the Grenfell Tower fire and Inquiry is an emphasis on keeping all occupants of residential buildings informed and satisfied with the actions of facilities managers. This is leading to a shift in attitude about occupation by Purpose Group, as Principle G.

Home Office

The Home Office published "Check your fire safety responsibilities under the Fire Safety (England) Regulations 2022" in December 2022, here:

https://www.gov.uk/government/publications/check-your-fire-safety-responsibilities-under-the-fire-safety-england-regulations-2022/check-your-fire-safety-responsibilities-under-the-fire-safety-england-regulations-2022

This guidance included a rudimentary "Template" for the "Responsible Person" to check the external wall. While also referring to the Publicly Available Specification (PAS) for a Fire Risk Appraisal of the External Wall (FRAEW) developed by the BSI in response to the Fire Safety Act 2021, and discussed below. The Home Office refers back to earlier guidance in July 2021 titled "Check your fire safety responsibilities under the Fire Safety Order", here:

https://www.gov.uk/guidance/check-your-fire-safety-responsibilities-under-the-fire-safety-order

Fire Safety Act 2021

The Fire Safety Act 2021 overwrote the RR(FS)O 2005. Whether the 2021 legislation was an amendment rather than a clarification to the 2005 law remains disputed, and may be contested in future.

https://www.legislation.gov.uk/ukpga/2021/24/contents

FSF links to services

The Fire Sector Federation (FSF) provides useful links to those providing Fire Risk Assessment (FRA) services to a recognised industry standard.

https://www.firesectorfederation.co.uk/fire-risk-assessment/

PAS 79 Parts 1 and 2

FRAs are carried out to a Publicly Available Specification (PAS):

- PAS 79-1:2020 *Fire risk assessment. Premises other than housing. Code of practice* https://shop.bsigroup.com/ProductDetail/?pid=000000000030401958
- PAS 79-2:2020 *Fire risk assessment. Housing. Code of practice*

However, PAS 79-2 was suspended by the British Standards Institution (BSI) because it failed to include universality in escape provisions.

https://www.bsigroup.com/en-GB/standards/pas-79-22020/

PEEPs

Personal Emergency Evacuation Plans (PEEPs) are considered as Principles C as part of the Evacuation Strategy, which is to be practised as Principle W. However, as part of the Evacuation Strategy, the FRA should recognise their personal content. PEEPs relate to natural persons as "Relevant Persons" for the fire risk assessor to consider in a specific building. PEEPs almost defy using a "Template" for the FRA, and the assessor has to know about the building occupants.

PEEPs were previously commonly used in offices and other workplaces. To help broaden the PEEP approach into the residential sector, the Fire Sector Federation (FSF) published a "Securing Safe Escape Checklist" in *Personal Emergency Evacuation General Residential Premises* Version 1 – Spring 2022.

https://www.firesectorfederation.co.uk/wp-content/uploads/2022/03/FINAL_FSF_SafeFireEscape.pdf

PAS 9980:2022

Within PAS 79-2, there was reference to PAS 9980, which went to public consultation in April 2021. The detailed PAS 9980:2022 *Fire risk appraisal of external wall construction and cladding of existing blocks of flats. Code of practice* is available to download free, along with an executive briefing.

https://www.bsigroup.com/en-GB/standards/pas-9980/

https://www.bsigroup.com/en-GB/standards/pas-9980/pas9980-thank-you/

https://www.bsigroup.com/en-GB/standards/pas-9980/executive-brief-thank-you/pas-9980-executive-briefing-form/

Compartmentation

FRAs shall involve checks on compartment walls and floors to ensure they are not breached, with proposals for action as Principle X. This suggests the use of BDM02 in pursuit of Principle I, by fire risk assessors instructed to go beyond the legal minimum of health and life safety and to consider property or asset protection, or the wider Resilience Strategy. The provisions the fire safety management have put in place for maintaining the Building Manual, as Principle W, will be important to the fire risk assessor, who may be visiting the building for the first time.

Moveable appliances

Persistent use of moveable heating and ventilation appliances beyond occasions of adverse weather is an indication that the integrated building services are not adequate for the comfort of occupants. In such cases, the potential for refurbishment should be raised by the fire risk assessor, rather than accept continued use of temporary measures.

Moveable heating and ventilation appliances shall be checked to ensure they are not a health and life safety risk in themselves. The HSE provides guidance on Portable Appliance Testing (PAT) for electrical equipment, and FAQs on gas safety, that building owners and operators should read and act upon.

https://www.hse.gov.uk/electricity/faq-portable-appliance-testing.htm

https://www.hse.gov.uk/gas/domestic/faqtenant.htm

Moveable heating and ventilation appliances represent an ignition risk when placed too close to combustible materials, whether among the contents or in the construction. As such they should be strictly controlled in their use by general facilities managers, more specialist fire safety managers, and the duty holding "Responsible Person", as Principle W.8. They should also be considered in the FRA period by addressing the underlying reason for their use.

Lithium-ion batteries

Moveable equipment with lithium-ion batteries require consideration in addition to those related to building services Principle F.12, discussed in BDM01-10.6. In Principle W the facilities manager needs to address the frontier of knowledge in lithium-ion battery use, discussed in BDM01-10.23, and the FRA shall consider the measures introduced over time. Some lithium-ion batteries may degrade over time, becoming more susceptible to failure in a runaway chemical reaction. The age of lithium-ion battery powered mobile devices may be a concern.

10.25 Principle Y – Keep Maintenance Commitments

Principle Y – Keep Maintenance Commitments

Inspect regularly, test and, when required, promptly maintain or replace structure, construction or building services systems over the life of the building, employing specialist operatives trained and supervised under third party certified schemes.

Y.1 Sprinklers serviced and maintained by BAFSA accredited contractors

Y.2 Service Life Planning resulting in a Maintenance Strategy and simple repair

Y.3 Schedule of primary, secondary, and tertiary components as Building Manual

Y.4 Identified operatives third party certified for construction as Principle T

Y.5 Quality of work and management third party certification schemes

Y.6 Compartmentation not impaired over time by degradations and breaches

Y.7 All building services access panels with fire resistance are kept locked

Y.8 Drainage for rainwater from roofs accessed to monitor and maintain

Y.9 Drainage for soil waste and grey water accessed to monitor and maintain

Y.10 Drainage to waterproofed areas accessed to monitor and maintain

Y.11 Solid waste refuse chutes and storage accessed to monitor and maintain

Y.12 Sprinkler system pressure is in accordance with the LPC Sprinkler Rules

Y.13 Pressure of all water systems other than sprinkler systems limited to 3.0 bar

Y.14 Water system outlet temperatures limited to a maximum 48°C

Y.15 SAEMA advice is followed, including a commitment to operative training

Y.16 Maintenance works are undertaken in compliance with LOLER and PUWER

Y.17 Scrupulous records of inspection and maintenance are kept for insurers

BAFSA guidance

RISCAuthority *Sprinkler System Service and Maintenance: Guidance, Records and Checklists*, published in June 2021 and endorsed by the British Automatic Fire Sprinkler Association (BAFSA), is available to general facilities managers, more specialist fire safety managers, and the duty holding "Responsible Person".

https://www.thefpa.co.uk/resource-download/603

Further guidance is available from BAFSA Information File BIF 16b *Sprinkler System Maintenance to BS EN 12845*, published in 2020.

https://www.bafsa.org.uk/wp-content/uploads/bsk-pdf-manager/2020/10/BIF16b.pdf

LPC Sprinkler Rules

Both the RISCAuthority and BAFSA maintenance guidance documents relate to the *LPC Rules for Automatic Sprinkler Installations 2015 incorporating BS EN 12845:2015+A1:2019 Fixed firefighting systems. Automatic sprinkler systems*, discussed as BDM01-6.5 and Principle I. The LPC Sprinkler Rules are updated with Technical Bulletins published by the RISCAuthority Sprinkler Working Group.

https://www.thefpa.co.uk/shop/lpc-sprinkler-rules-with-bsen12845-book

BS EN 12845:2015+A1:2019 *Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance* shall be referred to, but is in the process of being updated by the BSI. To keep up to date with the changes in BS EN 12845 and related guidance, it is important to instruct a third party certified specialist contractor as Principle U.

Contract loyalty

The best installers will want to undertake maintenance contracts of their own installation and these specialists should be favoured while their work and service prove to be of high quality. They should have provided third party certification of quality materials, products, and systems as Principle T. Due diligence in letting contracts is required because third party certified companies can face commercial or recruitment difficulties.

Trade associations

Several trade associations represent the facilities management sector, including some international bodies with considerable reach. Such bodies provide a range of resources for inspection, maintenance, repair, and replacement:

- International Facility Management Association (IFMA)
  https://www.ifma.org/
- Institute of Workplace and Facilities Management (IWFM)
  https://www.iwfm.org.uk/
- Royal Institution of Chartered Surveyors (RICS)
  https://www.rics.org/uk/
- Chartered Institute of Building (CIoB)
  https://www.ciob.org/
- Property Care Association (PCA)
  https://www.property-care.org/
- Wood Protection Association (WPA)
  https://www.thewpa.org.uk/

PCSA benefits

The planning of maintenance begins to be fixed in the Work Stage 2 concept design, prior to the application for planning approval, the building control application, and any contract with specialist contractors. A prospective main contractor may be appointed on a Pre-Contract Service Agreement (PCSA), but that is uncommon on smaller developments. The "Lead Designer" and the initial consultants require a grasp of practicalities unless they are to inadvertently drive future maintenance and replacement costs into their design.

Glass cleaning and replacement is the obvious example, where working at height is required, external to the building. It is not a trivial matter to require a Building Maintenance Unit (BMU) on a multi-storey building. Principle H.5 recognises the challenges to primary structure posed by a travelling BMU. The structural engineering shall accommodate the moving loads with their related but often disregarded acoustic challenges.

Reference shall be made to BS 8560:2012+A1:2018 *Code of practice for the design of buildings incorporating safe work at height*.

SAEMA guidance

The Specialist Access Engineering and Maintenance Association (SAEMA) is the national trade body for the permanent and temporary façade access equipment industry. SAEMA members provide specialist advice, which the sensible client will pay for on a PCSA basis.

https://www.saema.org/guidance/

Two regulations of interest to the Health and Safety Executive (HSE) are important for BMUs:

- The Provision and Use of Work Equipment Regulations (PUWER) 1998
  https://www.legislation.gov.uk/uksi/1998/2306/contents/made
- The Lifting Operations and Lifting Equipment Regulations (LOLER) 1998
  https://www.legislation.gov.uk/uksi/1998/2307/contents/made

In 2022, Lloyd's Building completed a large replacement and refurbishment of 17 roof mounted and soffit suspended BMUs, providing an exemplary case study.

Service Life Planning

The design life for the works is necessarily defined strategically in the Resilience Strategy. The service life for the materials, products, systems, and elements of the works should be declared in accordance with BS ISO 15686-1:2011 *Buildings and constructed assets. Service life planning. General principles and framework*, with the following practical terminology:

- **Primary components** that are structural, inaccessible, and prohibitively difficult or expensive to replace, with service life no less than the design life.
- **Secondary components** that are non-structural, accessible, and require major works to replace.
- **Tertiary components** that are non-structural, accessible, and require minor works to replace, which include components that will degrade rapidly to affect performance under anticipated conditions.

Maintenance modes

The service life for the primary, secondary, and tertiary components should be declared in accordance with BS 7543:2015 *Guide to durability of buildings and building elements, products and components*. The following terminology should be used to distinguish between modes of maintenance:

- **Lifelong**, where a primary component lasts for the life of the building without replacement or maintenance.
- **Maintainable**, where a non-replaceable primary component lasts for the life of the building with maintenance.
- **Replaceable**, where replacement is envisaged at design stage because a secondary or tertiary component has a shorter service life than the life of the building, even with maintenance.

Additionally, the building should be designed and constructed for planned and preventive maintenance so far as reasonably practicable, and that maintenance should be carried out. BS 8210:2020 *Facilities maintenance management. Code of practice* defines maintenance as planned, preventive or unplanned. In contrast, BS EN 13306:2017 *Maintenance terminology* allows other definitions of maintenance. **SFARP**

The principle of "so far as reasonably practicable" shall not be used as an excuse for poor architectural design. The impracticality of access for inspection, testing, maintenance, and replacement should not be designed into a building.

Difficulty of access becomes acute when cavity barriers requiring inspection at height are not primary components and require replacement during the design life of the building. It should be recognised that access over time is not addressed in a BS 8414 system scale test, discussed in BDM01-10.4 as Principle D.

10.26 Principle Z – Critically Review Experience

Principle Z – Critically Review Experience

Review whether the aspects of resilience originally required of the asset were realised practically over time, and share lessons learned to strengthen a culture of disclosure which can inform insurable strategies for future development projects.

Z.1 Long term relationship to undertake a Post-Occupancy Evaluation (POE)

Z.2 Culture of full disclosure for lessons learned in public, not only on project

Z.3 Success from one Resilience Strategy is repeated by strategists that follow

Z.4 Adopt Strategy, Testing, Inspection, Certification, and Compliance (STICC)

Feedback is very important if lessons are to be learned. After 2013, when the plan of work had its first major overhaul in its 57 year life, the RIBA consulted widely across the construction industry. The RIBA say:

"In June 2019 the UK Government committed to be net zero carbon by 2050, and the RIBA, along with a large proportion of the construction industry, believe that to meet this target we must design and construct new projects and undertake refurbishments that do not need to be retrofitted again before 2050. The RIBA have set a deadline of 2030 to do this, and for this to be successful the industry must be attempting it on all projects now."

Of course, "Sustainability" is not the same as resilience. People mean different things by elastic concepts. BDM01 is consciously trying to articulate what resilience means to the insurance sector, and what a Resilience Strategy expects.

RIBA commitment

Feedback is very important if lessons are to be learned. After 2013, when the plan of work had its first major overhaul in its 57 year life, the RIBA consulted widely across the construction industry. The RIBA say:

"In June 2019 the UK Government committed to be net zero carbon by 2050, and the RIBA, along with a large proportion of the construction industry, believe that to meet this target we must design and construct new projects and undertake refurbishments that do not need to be retrofitted again before 2050. The RIBA have set a deadline of 2030 to do this, and for this to be successful the industry must be attempting it on all projects now."

Of course, "Sustainability" is not the same as resilience. People mean different things by elastic concepts. BDM01 is consciously trying to articulate what resilience means to the insurance sector, and what a Resilience Strategy expects.

RIBA strategies

The *RIBA Plan of Work 2020* is also strategic in its thinking on the following core project strategies:

- Conservation Strategy
- Cost Strategy
- Fire Safety Strategy
- Health and Safety Strategy
- Inclusive Design Strategy
- Planning Strategy
- Plan for Use Strategy
- Procurement Strategy
- Sustainability Strategy

A Fire Safety Strategy for the *RIBA Plan of Work 2020* is not the same as the Evacuation, Fire, and Resilience Strategies outlined in BDM01.

Sustainability

The RIBA are pursuing a Sustainability Strategy that has defined outcomes.

https://www.architecture.com/knowledge-and-resources/resources-landing-page/sustainable-outcomes-guide

"An outcomes-based design approach will help resolve the now well-known gaps between design intent and in-use performance across a range of metrics and deliver real and lasting reductions in carbon emissions by reinforcing the feedback loop between briefing and outcomes. It complements mandatory requirements under Government Soft Landings, for UK and devolved governments to carry out Post-Occupancy Evaluation (POE) on all centrally funded public buildings and education projects, with the aim to reduce energy and running costs, and enhance health and wellbeing."

Categorisation

These metrics expect measurement, which is going to be difficult when language in construction is so mutable. As any specification writer will tell you, construction defies being categorised and classified as. There is always innovation. However, attempts need to be made to think about building buildings. .

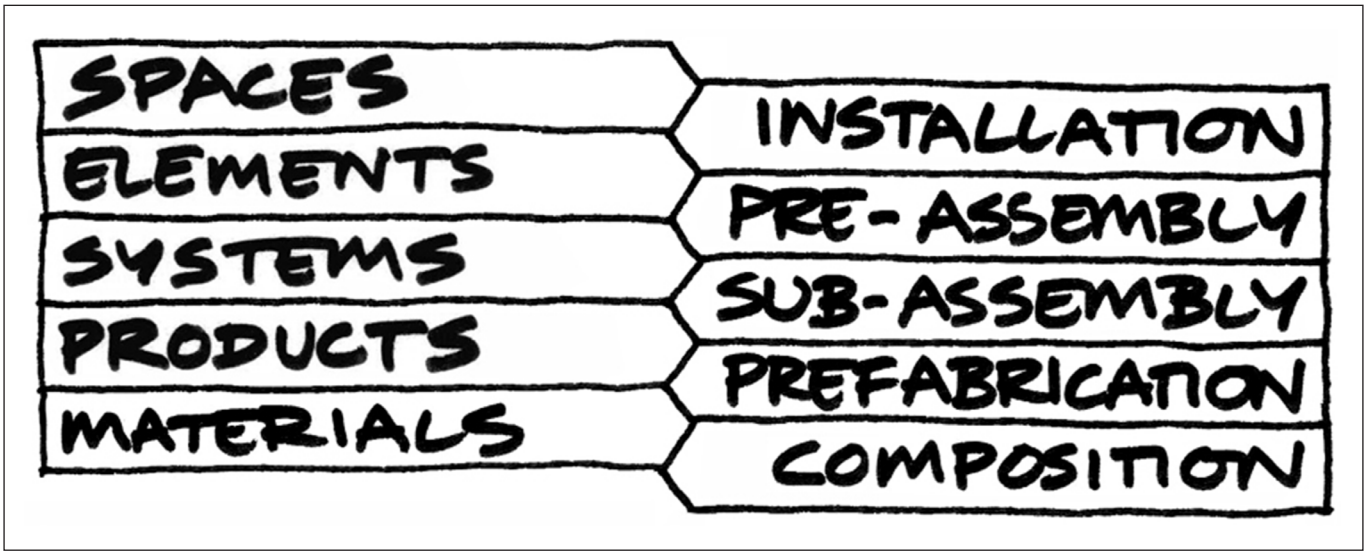

Figure BDM01-10.26.2 Hierarchy of Construction – RISCAuthority

Speculation

It is one thing to undertake a Post-Occupancy Evaluation (POE) on a single building, providing feedback to the building owner. It is quite another to share the lessons learned across common themes to a sector of investors, or with the wider construction industry, government, and the public. That is not a call to bureaucratically define the construction industry through Key Performance Indicators (KPIs), but rather to think in terms of principles.

A culture of full public disclosure is frustrated by various commercial confidences and proprietary secrecies. But business can also be done publicly. There is no commercial secret that the law provides the minimal requirements of Schedule 1 as BDM01-11, or Regulation 7 as BDM01-12, within the entirety of the Building Regulations 2010. How they are satisfied should be no confidentiality. However, compliance with that legislation is not enough to make a building, let alone a building that aspires to be architecture. Expectations should be raised, better standards sought, and innovation encouraged, to realise principles that are imaginative, and shared. Principle Z is speculative in a wider context.

BDM01 Keynote

RISCAuthority BDM01 *A to Z of Essential Principles for the protection of buildings* is an orderly recommendation to investors, on behalf of insurers, not to design and build solely down to the "life safety before collapse" objective on the assumption that the project is a "common building situation". Instead, to define and insist upon the resilience their investment requires, beyond statutory guidance or Building Regulations. It calls for resilient

construction innovation to improve health and life safety with measures anticipating likely events involving fire and water.

"Relevant Persons"

Identification and involvement of "Relevant Persons" is discussed as Principle G as a matter of developing trust. This cannot be legislated, and the range of "Relevant Persons" is wider than defined at any time in legislation. Trust has to be built between the natural persons who use and manage buildings.

This document has sought to avoid use of the term "stakeholder", as it lacks distinction between interests. The building users have different interests to the investors and insurers. The users of larger and more complex buildings will be a constituency of "Relevant Persons" with common and competing interests.

Appreciation of the interests of "Relevant Persons" in their various capacities, concerns, and expectations should be part of the process of improving a Resilience Strategy developed as Principle A. The critical review of experience among building users is a facilities management skill that investors and their managers dismiss at their peril. Trust can easily be lost. The quality of dialogue matters.

Dialogue

Insights from dialogue based in experience are pivotal if these insurer valued Principles are to be genuinely essential, providing useful reference points when annotating other guidance over time. The checklist action points as BDM01-9 need criticism. There may be redundancy and imprecision among them, or a significant gap in perception. The supporting notes as BDM01-10 may be irrelevant or in need of additional content, which is easily included in a digital publication.

Future revisions

Future revisions of BDM01 will be improved by insurer member, fire sector, construction industry and public discussion.

Critical thinking

Critical thinking on Strategy, Testing, Inspection, Certification, and Compliance (STICC), discussed as Principle S in BDM01-10.19, may be a good place to start.

11 Schedule 1 Requirements of the Building Regulations 2010 as amended 2022

Reference is made throughout BDM01 to Schedule 1 Requirements in the Building Regulations 2010, as amended by 21 July 2022. The legal requirements for building works in England are collated in this section. The Welsh version of these legal requirements may vary from the English, discussed as BDM01-5.

https://www.legislation.gov.uk/uksi/2010/2214/schedule/1

Schedule 1 refers to other legislation that has been amended, as follows:

- Section 33 Power to provide prisons, etc. of the Prison Act 1952
  https://www.legislation.gov.uk/ukpga/Geo6and1Eliz2/15-16/52/section/33
- Section 4 Schools of the Education Act 1996
  https://www.legislation.gov.uk/ukpga/1996/56/section/4
- Section 199 Sewer maps of the Water Industry Act 1991
  https://www.legislation.gov.uk/ukpga/1991/56/section/199
- Section 104 Agreements to adopt sewer, drain or sewage disposal works, at future date of the Water Industry Act 1991
  https://www.legislation.gov.uk/ukpga/1991/56/section/104
- Section 46 Receptacles for household waste and Section 47 Receptacles for commercial or industrial waste of the Environmental Protection Act 1990
  https://www.legislation.gov.uk/ukpga/1990/43/section/46
  https://www.legislation.gov.uk/ukpga/1990/43/section/47

The statutory guidance of the English and Welsh Approved Documents, indexed as BDM01-16, is arranged in the same order of alphabetical Parts as Schedule 1 Requirements, as follows:

11.1 Part A Structure

Loading

A1(1) The building shall be constructed so that the combined dead, imposed and wind loads are sustained and transmitted by it to the ground—

(a) safely; and

(b) without causing such deflection or deformation of any part of the building, or such movement of the ground, as will impair the stability of any part of another building.

A1(2) In assessing whether a building complies with sub-paragraph (1) regard shall be had to the imposed and wind loads to which it is likely to be subjected in the ordinary course of its use for the purpose for which it is intended.

Ground movement

A2 The building shall be constructed so that ground movement caused by—

(a) swelling, shrinkage or freezing of the subsoil; or

(b) land-slip or subsidence (other than subsidence arising from shrinkage), in so far as the risk can be reasonably foreseen, will not impair the stability of any part of the building.

Disproportionate collapse

A3 The building shall be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.

11.2 Part B Fire safety

Means of warning and escape

B1 The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

Limits on application

Requirement B1 does not apply to any prison provided under Section 33 of the Prison Act 1952, as amended.

Internal fire spread (linings)

B2(1) To inhibit the spread of fire within the building, the internal linings shall—

(a) adequately resist the spread of flame over their surfaces; and

(b) have, if ignited, either a rate of heat release or a rate of fire growth, which is reasonable in the circumstances.

B2(2) In this paragraph "internal linings" means the materials or products used in lining any partition, wall, ceiling or other internal structure.

Internal fire spread (structure)

B3(1) The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period.

B3(2) A wall common to two or more buildings shall be designed and constructed so that it adequately resists the spread of fire between those buildings. For the purposes of this sub-paragraph a house in a terrace and a semi-detached house are each to be treated as a separate building.

B3(3) Where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken, to an extent appropriate to the size and intended use of the building, comprising either or both of the following—

(a) sub-division of the building with fire-resisting construction;

(b) installation of suitable automatic fire suppression systems.

Limits on application

Requirement B3(3) does not apply to material alterations to any prison provided under section 33 of the Prison Act 1952, as amended.

B3(4) The building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

External fire spread

B4(1) The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.

B4(2) The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.

Access and facilities for the fire service

B5(1) The building shall be designed and constructed so as to provide reasonable facilities to assist fire fighters in the protection of life.

B5(2) Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building.

11.3 Part C Site preparation and resistance to contaminants and moisture

Preparation of site and resistance to contaminants

C1(1) The ground to be covered by the building shall be reasonably free from any material that might damage the building or affect its stability, including vegetable matter, topsoil and pre-existing foundations.

C1(2) Reasonable precautions shall be taken to avoid danger to health and safety caused by contaminants on or in the ground covered, or to be covered by the building and any land associated with the building.

C1(3) Adequate sub-soil drainage shall be provided, if it is needed to avoid—

(a) the passage of ground moisture to the interior of the building;

(b) damage to the building, including damage through the transport of water-borne contaminants to the foundations of the building.

C1(4) For the purposes of this requirement, "contaminant" means any substance which is or may become harmful to persons or buildings including substances which are corrosive, explosive, flammable, radioactive or toxic.

Resistance to moisture

C2 The walls, floors and roof of the building shall adequately protect the building and people who use the building from harmful effects caused by—

(a) ground moisture;

(b) precipitation including wind-driven spray;

(c) interstitial and surface condensation; and

(d) spillage of water from or associated with sanitary fittings or fixed appliances.

11.4 Part D Toxic substances

Cavity insulation

D1 If insulating material is inserted into a cavity in a cavity wall, reasonable precautions shall be taken to prevent the subsequent permeation of any toxic fumes from that material into any part of the building occupied by people.

11.5 Part E Resistance to the passage of sound

Protection against sound from other parts of the building and adjoining buildings

E1 Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings.

Protection against sound within a dwelling-house etc.

E2 Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that—

(a) internal walls between a bedroom or a room containing a water closet, and other rooms; and

(b) internal floors,

provide reasonable resistance to sound.

Limits on application

Requirement E2 does not apply to—

(a) an internal wall which contains a door;

(b) an internal wall which separates an en-suite toilet from the associated bedroom;

(c) existing walls and floors in a building which is subject to a material change of use.

Reverberation in common internal parts of buildings containing flats or rooms for residential purposes

E3 The common internal parts of buildings which contain flats or rooms for residential purposes shall be designed and constructed in such a way as to prevent more reverberation around the common parts than is reasonable.

Limits on application

Requirement E3 only applies to corridors, stairwells, hallways and entrance halls which give access to the flat or room for residential purposes.

Acoustic conditions in schools

E4(1) Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use.

E4(2) For the purposes of this Part—

"school" has the same meaning as in section 4 of the Education Act 1996, as amended; and

"school building" means any building forming a school or part of a school.

11.6 Part F Ventilation

Means of ventilation

F1(1) There shall be adequate means of ventilation provided for people in the building.

Limits on application

Requirement F1 does not apply to a building or space within a building—

(a) into which people do not normally go;

(b) which is used solely for storage; or

(c) which is a garage used solely in connection with a single dwelling.

F1(2) Fixed systems for mechanical ventilation and any associated controls must be commissioned by testing and adjusting as necessary to secure that the objective referred to in sub-paragraph (1) is met.

11.7 Part G Sanitation, hot water safety and water efficiency

Cold water supply

G1(1) There must be a suitable installation for the provision of—

(a) wholesome water to any place where drinking water is drawn off;

(b) wholesome water or softened wholesome water to any washbasin or bidet provided in or adjacent to a room containing a sanitary convenience;

(c) wholesome water or softened wholesome water to any washbasin, bidet, fixed bath and shower in a bathroom;

(d) wholesome water to any sink provided in any area where food is prepared.

G1(2) There must be a suitable installation for the provision of water of suitable quality to any sanitary convenience fitted with a flushing device.

Water efficiency of new dwellings

G2 Reasonable provision must be made by the installation of fittings and fixed appliances that use water efficiently for the prevention of undue consumption of water.

Limits on application

Requirement G2 applies only when a dwelling is—

(a) erected; or

(b) formed by a material change of use of a building within the meaning of regulation 5(a) or 5(b)

Water efficiency of new buildings other than dwellings and healthcare buildings

G2A Reasonable provision must be made in the design and installation of any sanitary convenience, washbasin or shower so as to prevent the undue consumption of water.

Limits on application

Requirement G2A applies only to building work that consists of the erection or extension of a building which is not a dwelling or a healthcare building.

"Healthcare building" means—

(a) a hospital;

(b) a building used for the provision of medical services by a registered medical practitioner;

(c) a building used for the provision of dental services by a person who under the Dentists Act 1984 is permitted to practise dentistry;

(d) a building not falling within paragraphs (b) or (c) which is used for the provision of primary medical services or primary dental services under the National Health Service Act 2006 or the National Health Service (Wales) Act 2006;

(e) a building at which a care home service, within the meaning of Part 1 of the Regulation and Inspection of Social Care (Wales) Act 2016 is provided.

Hot water supply and systems

G3(1) There must be a suitable installation for the provision of heated wholesome water or heated softened wholesome water to—

(a) any washbasin or bidet provided in or adjacent to a room containing a sanitary convenience;

(b) any washbasin, bidet, fixed bath and shower in a bathroom; and

(c) any sink provided in any area where food is prepared.

G3(2) A hot water system, including any cistern or other vessel that supplies water to or receives expansion water from a hot water system, must be designed, constructed and installed so as to resist the effects of temperature and pressure that may occur either in normal use or in the event of such malfunctions as may reasonably be anticipated, and must be adequately supported.

G3(3) A hot water system that has a hot water storage vessel must incorporate precautions to—

(a) prevent the temperature of the water stored in the vessel at any time exceeding 100°C;

(b) ensure that any discharge from safety devices is safely conveyed to where it is visible but will not cause a danger to persons in or about the building.

Limits on application

Requirement G3(3) does not apply to a system which heats or stores water for the purposes only of an industrial process.

G3(4) The hot water supply to any fixed bath must be so designed and installed as to incorporate measures to ensure that the temperature of the water that can be delivered to that bath does not exceed 48°C.

Limits on application

Requirement G3(4) applies only when a dwelling is—

(a) erected; or

(b) formed by a material change of use of a building within the meaning of Regulation 5(a), the building is used as a dwelling, where previously it was not, or 5(b), the building contains a flat, where previously it did not.

Sanitary conveniences and washing facilities

G4(1) Adequate and suitable sanitary conveniences must be provided in rooms provided to accommodate them or in bathrooms.

G4(2) Adequate hand washing facilities must be provided in—

(a) rooms containing sanitary conveniences; or

(b) rooms or spaces adjacent to rooms containing sanitary conveniences.

G4(3) Any room containing a sanitary convenience, a bidet, or any facility for washing hands provided in accordance with sub-paragraph (2)(b), must be separated from any kitchen or any area where food is prepared.

Bathrooms

G5 A bathroom must be provided containing a washbasin and either a fixed bath or a shower.

Limits on application

Requirement G5 applies only to dwellings and to buildings containing one or more rooms for residential purposes.

Kitchens and food preparation areas

G6 A suitable sink must be provided in any area where food is prepared.

11.8 Part H Drainage and waste disposal

Foul water drainage

H1(1) An adequate system of drainage shall be provided to carry foul water from appliances within the building to one of the following, listed in order of priority—

(a) a public sewer; or, where that is not reasonably practicable;

(b) a private sewer communicating with a public sewer; or, where that is not reasonably practicable;

(c) either a septic tank which has an appropriate form of secondary treatment or another wastewater treatment system; or, where that is not reasonably practicable;

(d) a cesspool.

Limits on application

Requirement H1 does not apply to the diversion of water which has been used for personal washing or for the washing of clothes, linen or other articles to collection systems for reuse.

H1(2) In this Part "foul water" means waste water which comprises or includes—

(a) waste from a sanitary convenience, bidet or appliance used for washing receptacles for foul waste; or

(b) water which has been used for food preparation, cooking or washing.

Wastewater treatment systems and cesspools

H2(1) Any septic tank and its form of secondary treatment, other wastewater treatment system or cesspool, shall be so sited and constructed that—

(a) it is not prejudicial to the health of any person;

(b) it will not contaminate any watercourse, underground water or water supply;

(c) there are adequate means of access for emptying and maintenance; and

(d) where relevant, it will function to a sufficient standard for the protection of health in the event of a power failure.

H2(2) Any septic tank or holding tank which is part of a wastewater treatment system or cesspool shall be—

(a) of adequate capacity;

(b) so constructed that it is impermeable to liquids; and

(c) adequately ventilated.

H2(3) Where a foul water drainage system from a building discharges to a septic tank, wastewater treatment system or cesspool, a durable notice shall be affixed in a suitable place in the building containing information on any continuing maintenance required to avoid risks to health.

Rainwater drainage

H3(1) Adequate provision shall be made for rainwater to be carried from the roof of the building.

H3(2) Paved areas around the building shall be so constructed as to be adequately drained.

Limits on application

Requirement H3(2) applies only to paved areas—

(a) which provide access to the building pursuant to requirement M1 (access and use), M1 (access to and use of buildings other than dwellings), requirement M2 (access to extensions to buildings other than dwellings), or requirement M4(1), (2) or (3) (access to and use of dwellings);

(b) which provide access to or from a place of storage pursuant to requirement H6(2) (solid waste storage); or

(c) in any passage giving access to the building, where this is intended to be used in common by the occupiers of one or more other buildings.

H3(3) Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority—

(a) an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable;

(b) a watercourse; or, where that is not reasonably practicable;

(c) a sewer.

Limits on application

Requirement H3(3) does not apply to the gathering of rainwater for reuse.

Building over sewers

H4(1) The erection or extension of a building or work involving the underpinning of a building shall be carried out in a way that is not detrimental to the building or building extension or to the continued maintenance of the drain, sewer or disposal main.

H4(2) In this paragraph "disposal main" means any pipe, tunnel or conduit used for the conveyance of effluent to or from a sewage disposal works, which is not a public sewer.

H4(3) In this paragraph and paragraph H5 "map of sewers" means any records kept by a sewerage undertaker under section 199 of the Water Industry Act 1991, as amended.

Limits on application

Requirement H4 applies only to work carried out—

(a) over a drain, sewer or disposal main which is shown on any map of sewers; or

(b) on any site or in such a manner as may result in interference with the use of, or obstruction of the access of any person to, any drain, sewer or disposal main which is shown on any map of sewers.

Separate systems of drainage

H5 Any system for discharging water to a sewer which is provided pursuant to paragraph H3 shall be separate from that provided for the conveyance of foul water from the building.

Limits on application

Requirement H5 applies only to a system provided in connection with the erection or extension of a building where it is reasonably practicable for the system to discharge directly or indirectly to a sewer for the separate conveyance of surface water which is—

(a) shown on a map of sewers; or

(b) under construction either by the sewerage undertaker or by some other person, where the sewer is the subject of an agreement to make a declaration of vesting pursuant to section 104 of the Water Industry Act 1991, as amended.

Solid waste storage

H6(1) Adequate provision shall be made for storage of solid waste.

H6(2) Adequate means of access shall be provided—

(a) for people in the building to the place of storage; and

(b) from the place of storage to a collection point (where one has been specified by the waste collection authority under section 46 (household waste) or section 47 (commercial waste) of the Environmental Protection Act 1990, as amended) or to a street (where no collection point has been specified).

11.9 Part J Combustion appliances and fuel storage systems

Air supply

J1 Combustion appliances shall be so installed that there is an adequate supply of air to them for combustion, to prevent over-heating and for the efficient working of any flue.

Limits on application

Requirement J1 applies only to fixed combustion appliances (including incinerators).

Discharge of products of combustion

J2 Combustion appliances shall have adequate provision for the discharge of products of combustion to the outside air.

Limits on application

Requirement J2 applies only to fixed combustion appliances (including incinerators).

Warning of release of carbon monoxide

J3 Where a combustion appliance is provided, appropriate provision having regard to the design and location of the appliance shall be made to detect and give early warning of the release of carbon monoxide at levels harmful to persons.

Limits on application

Requirement J3 applies only to fixed combustion appliances located in dwellings.

Protection of building

J4 Combustion appliances and flue-pipes shall be so installed, and fireplaces and chimneys shall be so constructed and installed, as to reduce to a reasonable level the risk of people suffering burns or the building catching fire in consequence of their use.

Limits on application

Requirement J4 applies only to fixed combustion appliances (including incinerators).

Provision of information

J5 Where a hearth, fireplace, flue or chimney is provided or extended, a durable notice containing information on the performance capabilities of the hearth, fireplace, flue or chimney shall be affixed in a suitable place in the building for the purpose of enabling combustion appliances to be safely installed.

Protection of liquid fuel storage systems

J6 Liquid fuel storage systems and the pipes connecting them to combustion appliances shall be so constructed and separated from buildings and the boundary of the premises as to reduce to a reasonable level the risk of the fuel igniting in the event of fire in adjacent buildings or premises.

Limits on application

Requirement J6 applies only to—

(a) fixed oil storage tanks with capacities greater than 90 litres and connecting pipes; and

(b) fixed liquefied petroleum gas storage installations with capacities greater than 150 litres and connecting pipes,

which are located outside the building and which serve fixed combustion appliances (including incinerators) in the building.

Protection against pollution

J7 Oil storage tanks and the pipes connecting them to combustion appliances shall—

(a) be so constructed and protected as to reduce to a reasonable level the risk of the oil escaping and causing pollution; and

(b) have affixed in a prominent position a durable notice containing information on how to respond to an oil escape so as to reduce to a reasonable level the risk of pollution.

Limits on application

Requirement J7 applies only to fixed oil storage tanks with capacities of 3,500 litres or less, and connecting pipes, which are—

(a) located outside the building; and

(b) serve fixed combustion appliances (including incinerators) in a building used wholly or mainly as a private dwelling,

but does not apply to buried systems.

11.10 Part K Protection from falling, collision and impact

Part K Protection from falling, collision and impact, was extended in 2013 by incorporation of the functional requirements previously in Part N Glazing – safety in relation to impact, opening and cleaning, which was then withdrawn and the statutory guidance archived.

https://www.planningportal.co.uk/applications/building-control-applications/building-control/approved-documents/part-n-glazing-safety-withdrawn/part-n-previous-editions

Stairs, ladders and ramps

K1 Stairs, ladders and ramps shall be so designed, constructed and installed as to be safe for people moving between different levels in or about the building.

Limits on application

Requirement K1 applies only to stairs, ladders and ramps which form part of the building.

Protection from falling

K2 (a) Any stairs, ramps, floors and balconies and any roof to which people have access, and

(b) any light well, basement area or similar sunken area connected to a building,

shall be provided with barriers where it is necessary to protect people in or about the building from falling.

Limits on application

Requirement K2(a) applies only to stairs and ramps which form part of the building.

Vehicle barriers and loading bays

K3(1) Vehicle ramps and any levels in a building to which vehicles have access, shall be provided with barriers where it is necessary to protect people in or about the building.

K3(2) Vehicle loading bays shall be constructed in such a way, or be provided with such features, as may be necessary to protect people in them from collision with vehicles.

Protection against impact with glazing

K4 Glazing, with which people are likely to come into contact while moving in or about the building, shall—

(a) if broken on impact, break in a way which is unlikely to cause injury; or

(b) resist impact without breaking; or

(c) be shielded or protected from impact.

Protection from collision with open windows etc.

K5(1) Provisions shall be made to prevent people moving in or about the building from colliding with open windows, skylights or ventilators.

Limits on application

Requirement K5(1) does not apply to dwellings.

Manifestation of glazing

K5(2) Transparent glazing with which people are likely to come into contact while moving in and about the building, shall incorporate features which make it apparent.

Limits on application

Requirement K5(2) does not apply to dwellings.

Safe opening and closing of windows etc.

K5(3) Windows, skylights and ventilators which can be opened by people in or about the building shall be so constructed or equipped that they may be opened, closed or adjusted safely.

Limits on application

Requirement K5(3) does not apply to dwellings.

Safe access for cleaning windows etc.

K5(4) Provision shall be made for any windows, skylights or translucent walls, ceilings or roofs to be safely accessible for cleaning.

Limits on application

Requirement K5(4) does not apply to—

(a) dwellings; or

(b) any door or gate which is part of a lift.

Protection against impact from and trapping by doors

K6(1) Provision shall be made to prevent any door or gate—

(a) which slides or opens upwards, from falling onto any person; and

(b) which is powered, from trapping any person.

K6(2) Provision shall be made for powered doors and gates to be opened in the event of a power failure.

K6(3) Provision shall be made to ensure a clear view of the space on either side of a swing door or gate.

Limits on application

Requirement K6 does not apply to—

(a) dwellings; or

(b) any door or gate which is part of a lift.

11.11 Part L Conservation of fuel and power

Conservation of fuel and power

L1 Reasonable provision shall be made for the conservation of fuel and power in buildings by—

(a) limiting heat gains and losses—

(i) through thermal elements and other parts of the building fabric; and

(ii) from pipes, ducts and vessels used for space heating, space cooling and hot water services;

(b) providing fixed building services which—

(i) are energy efficient to a reasonable standard;

(ii) have effective controls; and

(iii) are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances.

On-site generation of electricity

L2 Where a system for on-site electricity generation is installed—

(a) reasonable provision must be made to ensure that—

(i) the system and its electrical output are appropriately sized for the site and available infrastructure;

(ii) the system has effective controls; and

(b) it must be commissioned by testing and adjusting as necessary to ensure that it produces the maximum electricity that is reasonable in the circumstances.

11.12 Part M Access to and use of buildings

Access to and use of buildings other than dwellings

M1 Reasonable provision must be made for people to—

(a) gain access to; and

(b) use, the building and its facilities.

Limits on application

Requirement M1 does not apply to any part of a building that is used solely to enable the building or any service or fitting in the building to be inspected, repaired or maintained.

Access to extensions to buildings other than dwellings

M2 Suitable independent access must be provided to the extension where reasonably practicable.

Limits on application

Requirement M2 does not apply where suitable access to the extension is provided through the building that is extended.

Sanitary conveniences in extensions to buildings other than dwellings

M3 If sanitary conveniences are provided in any building that is to be extended, reasonable provision shall be made within the extension for sanitary conveniences.

Limits on application

Requirement M3 does not apply where there is reasonable provision for sanitary conveniences elsewhere in the building, such that people occupied in, or otherwise having occasion to enter the extension, can gain access to and use those sanitary conveniences.

Access to and use of dwellings

Category 1 – visitable dwelling

M4(1) Reasonable provision must be made for people to—

(a) gain access to; and

(b) use, the dwelling and its facilities.

Limits on application

Requirement M4(1) does not apply to—

(a) an extension to a dwelling; or

(b) any part of a building that is used solely to enable the building or any service or fitting in the building to be inspected, repaired or maintained.

Category 2 – accessible and adaptable dwellings

M4(2)(1)Reasonable provision must be made for people to—

(a) gain access to; and

(b) use, the dwelling and its facilities.

M4(2)(2)The provision made must be sufficient to—

(a) meet the needs of occupants with differing needs, including some older or disabled people; and

(b) to allow adaptation of the dwelling to meet the changing needs of occupants over time.

Limits on application

Optional requirement M4(2)—

(a) may apply only in relation to a dwelling that is erected;

(b) will apply in substitution for requirement M4(1);

(c) does not apply where optional requirement M4(3) applies;

(d) does not apply to any part of a building that is used solely to enable the building or any service or fitting in the building to be inspected, repaired or maintained.

Category 3 – wheelchair user dwellings

M4(3)(1)Reasonable provision must be made for people to—

(a) gain access to; and

(b) use, the dwelling and its facilities.

M4(3)(2)The provision made must be sufficient to—

(a) allow simple adaptation of the dwelling to meet the needs of occupants who use wheelchairs; or

(b) meet the needs of occupants who use wheelchairs.

Limits on application

Optional requirement M4(3)—

(a) may apply only in relation to a dwelling that is erected;

(b) will apply in substitution for requirement M4(1);

(c) does not apply where optional requirement M4(2) applies;

(d) does not apply to any part of a building that is used solely to enable the building or any service or fitting in the building to be inspected, repaired or maintained.

Optional requirement M4(3)(2)(b) applies only where the planning permission under which the building work is carried out specifies that it shall be complied with.

11.13 Part O Overheating

Overheating mitigation

O1(1) Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel ("residences") to—

(a) limit unwanted solar gains in summer;

(b) provide an adequate means to remove heat from the indoor environment.

O1(2) In meeting the obligations in paragraph (1)—

(a) account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and

(b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.

11.14 Part P Electrical safety

Design and installation

P1 Reasonable provision shall be made in the design and installation of electrical installations in order to protect persons operating, maintaining or altering the installations from fire or injury.

Limits on application

The requirements of this Part apply only to electrical installations that are intended to operate at low or extra-low voltage and are—

(a) in or attached to a dwelling;

(b) in the common parts of a building serving one or more dwellings, but excluding power supplies to lifts;

(c) in a building that receives its electricity from a source located within or shared with a dwelling; or

(d) in a garden or in or on land associated with a building where the electricity is from a source located within or shared with a dwelling.

11.15 Part Q Security

Unauthorised access

Q1 Reasonable provision must be made to resist unauthorised access to—

(a) any dwelling; and

(b) any part of a building from which access can be gained to a flat within the building.

Limits on application

Requirement Q1 applies only in relation to new dwellings.

11.16 Part R Physical infrastructure for high-speed electronic communications networks

In-building physical infrastructure

R1(1) Building work must be carried out so as to ensure that the building is equipped with a high-speed-ready in-building physical infrastructure, up to a network termination point for high-speed electronic communication networks.

Limits on application

Requirement R1 applies to building work that consists of—

(a) the erection of a building; or

(b) major renovation works to a building.

R1(2) Where the work concerns a building containing more than one dwelling, the work must be carried out so as to ensure that the building is equipped in addition with a common access point for high-speed electronic communications networks.

11.17 Part S Infrastructure for the charging of electric vehicles

The erection of new residential buildings

S1(1) A new residential building with associated parking must have access to electric vehicle charge points as provided for in paragraph (2).

S1(2) The number of associated parking spaces which have access to electric vehicle charge points must be—

(a) the total number of associated parking spaces, where there are fewer associated parking spaces than there are dwellings contained in the residential building; or

(b) the number of associated parking spaces that is equal to the total number of dwellings contained in the residential building, where there are the same number of associated parking spaces as, or more associated parking spaces than, there are dwellings.

S1(3) Cable routes for electric vehicle charge points must be installed in any associated parking spaces which do not, in accordance with paragraph (2), have an electric vehicle charge point where—

(a) a new residential building has more than 10 associated parking spaces; and

(b) there are more associated parking spaces than there are dwellings contained in the residential building.

Dwellings resulting from a material change of use

S2 Where one or more dwellings with associated parking result from a building, or a part of a building, undergoing a material change of use at least one associated parking space for the use of each such dwelling must have access to an electric vehicle charge point.

Residential buildings undergoing major renovation

S3 Where a residential building undergoing major renovation will have more than 10 associated parking spaces after the major renovation is completed—

(a) at least one associated parking space for the use of each dwelling must have access to an electric vehicle charge point;

(b) cable routes for electric vehicle charge points must be installed in all additional associated parking spaces.

Erection of new buildings which are not residential buildings or mixed-use buildings

S4 Where a new building which is not a residential building or a mixed-use building has more than 10 parking spaces—

(a) one of those parking spaces must have access to one electric vehicle charge point; and

(b) cable routes for electric vehicle charge points must be installed in a minimum of one fifth of the total number of remaining parking spaces.

Buildings undergoing major renovation which are not residential buildings or mixed-use buildings

S5 Where a building undergoing major renovation, which is not a residential building or a mixed-use building, will have more than 10 parking spaces after the major renovation is completed—

(a) one of those parking spaces must have access to one electric vehicle charge point; and

(b) cable routes for electric vehicle charge points must be installed in a minimum of one fifth of the total number of remaining parking spaces.

The erection of new mixed-use buildings and mixed-use buildings undergoing major renovation

S6(1) The requirements of paragraph S1 apply in respect of the part of the new mixed-use building that contains one or more dwellings and the associated parking spaces that are assigned to those dwellings.

S6(2) The requirements of paragraph S3 apply in respect of the part of the mixed-use building that is undergoing major renovation that contains one or more dwellings and the associated parking spaces that are assigned to those dwellings.

S6(3) The requirements of paragraph S4 apply in respect of the part of the new mixed-use building that contains one or more new premises that are not dwellings and the parking spaces that are assigned to those premises.

S6(4) The requirements of paragraph S5 apply in respect of the part of the mixed-use building that is undergoing major renovation that contains one or more premises that are not dwellings and the parking spaces that are assigned to those premises.

12 Regulation 7 and Approved Document 7 as amended 2018 and 2022

Regulation 7 of the Building Regulations 2010, as amended, is here:

https://www.legislation.gov.uk/uksi/2010/2214/regulation/7

This pivotal Regulation is unusual in that it has a dedicated Approved Document:

(E-AD-7)

Approved Document 7: Material and workmanship

(2013 as amended 2018)

https://www.gov.uk/government/publications/material-and-workmanship-approved-document-7

BDM01-16 (E-AD-7) is not like the other Approved Documents based in Schedule 1 Requirements of the Building Regulations 2010. (E-AD-7) was issued when the European Union Regulation 305/2011 of 2011 led to the Construction Products Regulations (CPR) 2013, mandating publication of a Declaration of Performance (DoP) by manufacturers. Prior to that, the Construction Products Directive (CPD) of 1989, based on European Economic Council Directive 89/106/EEC, had been voluntary and consequently largely ineffective.

https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:31989L0106

https://www.legislation.gov.uk/eudr/1989/106/adopted

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32011R0305

https://www.legislation.gov.uk/eur/2011/305/contents

www.legislation.gov.uk/uksi/2013/1387/contents

The CPR 2013 DoP was a formalised disclosure that said nothing about how a product could be applied. It was meant only to be a manufacturer's statement of tested and classified characteristics, with which clients, contractors, and consultants should make a judgement about "fitness for purpose".

The CPR 2013 provisions are being superseded in the UK after the Construction Products (Amendment etc.)(EU Exit) Regulations 2019, Construction Products (Amendment etc.)(EU Exit) Regulations 2020, and as Schedule 11 of the Building Safety Act 2022.

https://www.legislation.gov.uk/uksi/2019/465/contents

https://www.legislation.gov.uk/uksi/2020/1359/contents

https://www.legislation.gov.uk/ukpga/2022/30/schedule/11

Regulation 7(1) of the Building Regulations 2010, as amended, is briefly stated but concerns (a) materials as Principle T and (b) quality of work as Principle U:

Materials and workmanship

Building work shall be carried out—

(a) with adequate and proper materials which—

  (i) are appropriate for the circumstances in which they are used,

  (ii) are adequately mixed or prepared, and

  (iii) are applied, used or fixed so as adequately to perform the functions for which they are designed; and

(b) in a workmanlike manner.

Regulation 7 was amended but also significantly extended after the Grenfell Tower fire, to date by two further statutes:

- Building (Amendment) Regulations 2018
  https://www.legislation.gov.uk/uksi/2018/1230/contents/made
- Building etc. (Amendment) (England) Regulations 2022
  https://www.legislation.gov.uk/uksi/2022/603/contents/made

These legal amendments prescribe the non-combustibility of specific component parts of the external wall in particular buildings.

In 2018, the distinction of a "Relevant Building" was created as Regulation 7(4) of the Building Regulations 2010, as amended. In 2022, Regulation 7(4)(a)(iii) was further amended to omit "(excluding any room in a hostel, hotel or boarding house)". Meaning that currently Regulation 7(4) says:

(a) a "relevant building" means a building with a storey (not including roof-top plant areas or any storey consisting exclusively of plant rooms) at least 18 metres above ground level and which—

  (i) contains one or more dwellings;

  (ii) contains an institution; or

  (iii) contains a room for residential purposes ~~(excluding any room in a hostel, hotel or boarding house)~~; and

(b) "above ground level" in relation to a storey means above ground level when measured from the lowest ground level adjoining the outside of a building to the top of the floor surface of the storey.

Regulation 7(2) of the Building Regulations 2010, as amended, then says for "Relevant Buildings" in Purpose Groups 1 and 2 as BDM02 that:

"Subject to paragraph (3), building work shall be carried out so that materials which become part of an external wall, or specified attachment, of a relevant building are of European Classification A2-s1, d0 or A1, classified in accordance with BS EN 13501-1:2007+A1:2009 entitled "Fire classification of construction products and building elements. Classification using test data from reaction to fire tests".

Regulation 7(3) is a list of exclusions in 2018 as amended 2022, meaning Regulation 7(2) for "Relevant Buildings" as Regulation 7(4) does not apply to:

(a) cavity trays when used between two leaves of masonry;

(b) any part of a roof (other than any part of a roof which falls within paragraph (iv) of regulation 2(6)) if that part is connected to an external wall;

(c) door frames and doors;

(d) electrical installations;

(da) fibre optic cables;

(e) insulation and water proofing materials used below ground level or up to 300mm above that level;

(f) intumescent and fire stopping materials where the inclusion of the materials is necessary to meet the requirements of Part B of Schedule 1;

(g) membranes;

(h) seals, gaskets, fixings, sealants and backer rods;

(ha) components associated with a solar shading device excluding components whose primary function is to provide shade or deflect sunlight such as the awning curtain or slats

(i) thermal break materials where the inclusion of the materials is necessary to meet the thermal bridging requirements of Part L of Schedule 1;

(j) window frames and glass; or

(k) materials which form the top horizontal floor layer of a balcony which are of European Classification A1fl or A2fl-sl (classified in accordance with the reaction to fire classification) provided that the entire layer has an imperforate substrate under it.

Other exclusions may be added over time, and manufacturers are lobbying to achieve advantage. Principle D.2 is then limited to Regulations 7(2) with 7(3) exceptions for 7(4) high-rise "Relevant Buildings" in Purpose Groups 1 and 2.

The Centre for Window and Cladding Technology (CWCT) and the Society of Façade Engineering (SFE) published *CWCT-SFE Fire Guidance* in September 2020 as close examination of the Building (Amendment) Regulations 2018, which predates the 2022 amendments, discussed in BDM01-10.4 as Principle D.

www.cwct.co.uk/pages/cwct-sfe-fire-guidance

The Building Regulations 2010, amended in Regulation 2(6)(c) by the Building etc. (Amendment)(England) Regulations 2022, further prohibit the use of "relevant metal composite materials" in the external walls of all buildings of any height:

(c) "relevant metal composite material" means any panel or sheet, having a thickness of no more than 10mm, which is comprised of a number of layers—

(i) two or more of which are made of metal, alloy or metal compound; and

(ii) one or more of which is substantial and is made of a material having a gross calorific value of more than 35 MJ/kg when tested in accordance with BS EN ISO 1716:2018 entitled "Reaction to fire tests for products – Determination of the gross heat of combustion (calorific value)" published by the British Standards Institution in 2018;

and for these purposes a substantial layer is one which is at least 1mm thick or has a mass per unit area of at least 1kg per m^2.

Regulation 7(1A) in BDM01-16 (E-AD-B) then says:

"Building work shall be carried out so that relevant metal composite material does not become part of an external wall, or specified attachment, of any building."

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1080214/ADB_amendment_booklet_June_2022.pdf

This is a technical threshold for Metal Composite Materials (MCM), which includes Aluminium Composite Materials (ACM), as were used in the refurbishment of Grenfell Tower, above a gross calorific value of more than 35 MJ/kg when tested in accordance with BS EN ISO 1716:2018 *Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value).* This is discussed further in BDM01-10.4 supporting notes for Principle D, and illustrated in BDM01-13.2.

The technical threshold of the MCM prohibition in law has been set at 35 MJ/kg because setting a lower gross calorific value threshold would limit the wider market for combustible claddings, which include timber at above 15 MJ/kg. That is entirely a policy decision to maintain a market in combustible claddings, because non-combustible materials allowing minimal smoke but no melting droplets have a gross calorific value of 3 MJ/kg or less. Indeed, the now deprecated "limited combustibility" had a gross calorific value of 3 MJ/kg or less, but with no limit on smoke or melting droplets.

There is no universal prohibition on combustible materials in the external wall. The limitation on "relevant metal composite materials" allows combustible MCM with a gross calorific value of less than 35 MJ/kg, while no legally binding technical threshold is set on other cladding products within the external wall. Principle D continues to be highly relevant for most construction.

Similar amendments for MCM cladding of >35 MJ/kg were being made in the other devolved administrations in 2022, at the time of publication, all with the same policy towards the wider market for combustible cladding.

13 Descriptions of test equipment in fire classification

This section provides illustrated descriptions of test equipment used in classification standards.

Beginning with the four test standards referred to in BS EN 13501-1:2018 *Fire classification of construction products and building elements. Classification using data from reaction to fire tests*, Table 1, as discussed in Principle D:

13.1 BS EN ISO 1182 Furnace Test

13.2 BS EN ISO 1716 Bomb Calorimeter Test

13.3 BS EN 13823 Single Burning Item Test

13.4 BS EN ISO 11925-2 Single Flame Test

A future revision of BDM01 will look at the other testing equipment under BS EN 13501-1 for flooring and linear pipe thermal insulation, and the other Parts of the BS EN 13501 series listed as BDM01-6.6.

This overview may be better achieved as a separate title in the BDM series, with the assistance of UKAS accredited test authorities. It may also be that a reliable publication by others obviates the need to show product scale testing.

13.1 BS EN ISO 1182 Furnace Test

The current version of the Standard is:

BS EN ISO 1182:2020 *Reaction to fire tests for products. Non-combustibility test*.

Superseded versions of the standard were dated 2010 and 2002. The standard was revised following a Draft for Public Comment as 19/30338546 DC BS EN ISO 1182 *Reaction to fire tests for products. Non-combustibility test*. The small-scale test equipment is the same Furnace that is used for BS 476-11:1982 *Fire tests on building materials and structures. Method for assessing the heat emission from building materials*. BS 476-11:1982 is currently under review.

Figure BDM01-13.1.1 Furnace – Warringtonfire

Figure BDM01-13.1.2 Furnace – Warringtonfire

Figure BDM01-13.1.3 Furnace – Warringtonfire

Figure BDM01-13.1.4 Furnace – Warringtonfire

13.2 BS EN ISO 1716 Bomb Calorimeter Test

The current version of the Standard is:

BS EN ISO 1716:2018 *Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)*

Superseded versions of the standard were dated 2010 and 2002. The Bomb Calorimeter equipment is small-scale and each material in a composite product is tested separately in small, measured quantities. Metals and particularly Aluminium may not be tested in the Bomb Calorimeter because there is a risk of serious injuries to the operator and damage to the equipment due to overheating and explosion. Metals are awarded a zero contribution to gross heat of combustion.

Figure BDM01-13.2.1 Bomb Calorimeter – Warringtonfire

Figure BDM01-13.2.2 Bomb Calorimeter – Warringtonfire

Figure BDM01-13.2.3 Bomb Calorimeter – Warringtonfire

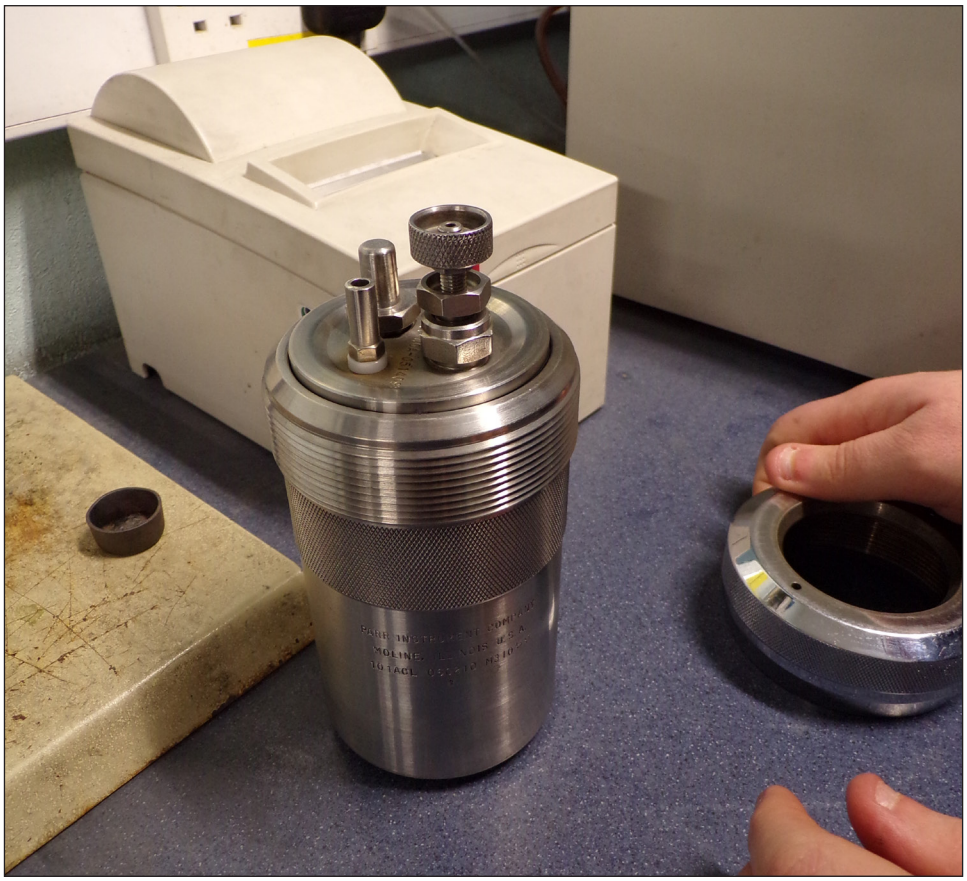

Figure BDM01-13.2.4 Bomb Calorimeter – Warringtonfire

13.3 BS EN 13823 Single Burning Item Test

The current version of the Standard is:

BS EN 13823:2020 *Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item*

Superseded versions of the standard were dated 2010, amended in 2014, and 2002. The homogenous material or composite product is tested as a whole but configured in the corner of a small-scale trolley on casters. The configuration of the joints in this test are important. It is not a system test and is limited in the way cavities behind the products are tested. The trolley is inserted and sealed into the Single Burning Item test chamber with smoke extract, which has an adjacent and remote room from where observations and measurements are taken.

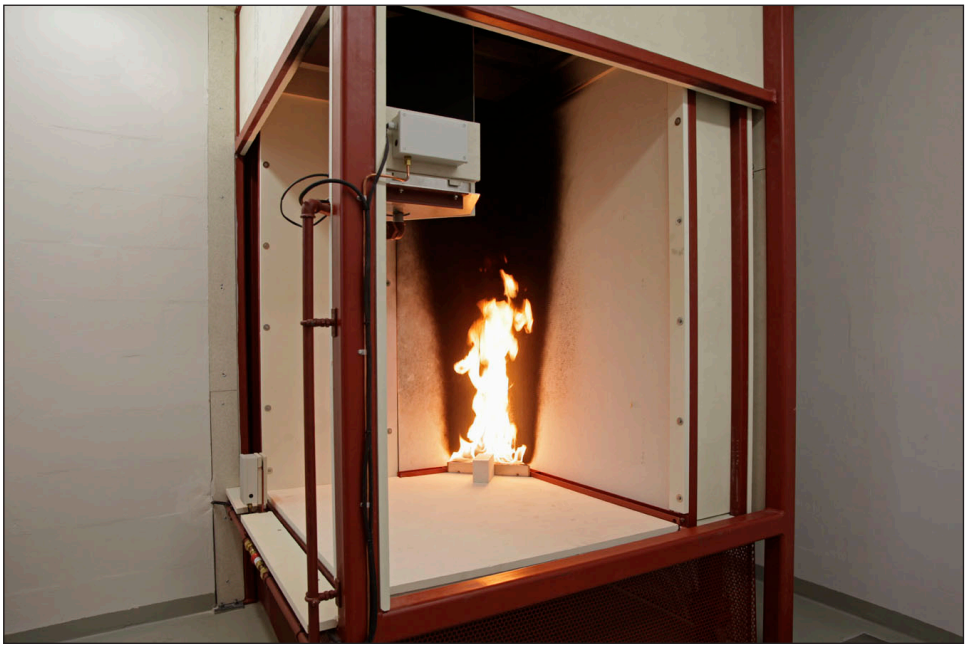

Figure BDM01-13.3.1 Single Burning Item – Warringtonfire

Figure BDM01-13.3.2 Single Burning Item – Warringtonfire

Figure BDM01-13.3.3 Single Burning Item – Warringtonfire

Figure BDM01-13.3.4 Single Burning Item – Warringtonfire

13.4 BS EN ISO 11925-2 Single Flame Test

The current version of the Standard is:

BS EN ISO 11925-2:2020 *Reaction to fire tests. Ignitability of products subjected to direct impingement of flame. Single-flame source test*

Superseded versions of the standard were dated 2010, 2002 and 1997. The homogenous material or composite product is tested as a whole, as a flat specimen held on a frame within a small-scale chamber. The hand moved single flame is positioned to burn the edge of the specimen. The exposure of the edge to the flame is important in comparison to small scale tests in the BS 476 series which tend to have edge protection and concentrate on surface reactions.

Figure BDM01-13.4.1 Single Flame – Warringtonfire

Figure BDM01-13.4.2 Single Flame – Warringtonfire

Figure BDM01-13.4.3 Single Flame – Warringtonfire

Figure BDM01-13.4.4 Single Flame – Warringtonfire

14 Short glossary of terms

The reader may refer to two standard vocabularies, differences between them as current standards, and the deprecations of phrases and meanings over time:

- BS EN ISO 13943:2017 *Fire safety. Vocabulary*
- BS 4422:2005 *Fire. Vocabulary*

In a future revision of BDM01, a more extensive Glossary may be considered beneficial. At this time a short list of meanings have been highlighted.

SFARP

The principle of "so far as reasonably practicable" (SFARP) shall not be used as an excuse for poor strategic planning, design, construction, maintenance or management, as discussed in Principle B.

Purpose Group

Building uses are classified by purpose in Table 0.1 Purpose Groups in the English statutory guidance of both Volumes of BDM01-16 (E-AD-B). Where compartments of buildings are used for several purposes, the more onerous Purpose Group guidance shall be applied. Purpose Groups are broad and it is necessary to consider the distinctions of building uses within them and the range of occupants who use them. This is done on a site or project specific basis.

Mixed Use

Mixed Use buildings require compartments to be assigned to a Purpose Group and arranged within the building as discussed in BDM02 *Fire protection of buildings – Core Document – Compartmentation and Sprinkler Rules* Version 2 – 2022.

https://www.thefpa.co.uk/resource-download/405

Dampers

There is an important distinction between fire dampers and smoke control dampers that requires recognition, as articulated by Paul White in *Smoke Control Dampers*, published 2020. The phrase "fire and smoke damper" is deprecated.

https://www.ventilationfiresmoke.com/smoke-control-dampers-book

Client

The finance for development comes from an investor. The client for building work may be the investor or may be managing the investments of others. A client may also be considered as, or may style themselves as, a "developer". They may be developing a building on a new site or refurbishing an existing one, either speculatively for sale or to retain as an asset, either to rent or to retain for their own use. We have referred to the building owner or operator rather than the client where that has meaning under the Regulatory Reform (Fire Safety) Order 2005 for the formal appointment of a "Responsible Person". We recognise also that the client may change during the development programme, and not only after handover as the legal precision of building owner or operator anticipates.

Employer

In a contract, the client may be the "Employer". The client's consultants will tender for contractors by producing contract documents that comprise the Employer's Requirements. Some consultants may be retained to support the client during the construction phase contract, while others may be "novated" to the contractor's side, or additional consultants appointed. Without being contract specific, BDM01 suggests that the Employer's Requirements are not limited to but may contain:

- Project Brief
- Resilience Strategy
- Fire Strategy based on Evacuation Strategy
- Planning Approval and Reserved Matters Schedule
- Movements and Tolerances Report for non-fire and fire situations
- Construction Service Life Planning to BS ISO 15686 and Maintenance Strategy
- CDM 2015 Health and Safety File from the "Principal Designer"
- Specification and Submittal list for the "Principal Contractor"
- Regulation 38 Fire Safety Information template
- Building Manual template

CDM 2015

The CDM 2015 Health and Safety File is developed by the "Principal Designer" and in turn responded to by the "Principal Contractor", who provides the residual document to the client at handover. This is in accordance with the Construction (Design and Management) Regulations 2015, as guided by the Health and Safety Executive (HSE) as the regulator. This is a statutory health and life safety requirement for any substantial building works. BDM01-10.2 considers CDM 2015.

www.hse.gov.uk/construction/cdm/2015/index.htm

Regulation 38

The Regulation 38 Fire Safety Information exchange is required at handover by the Building Regulations 2010, to inform the "Responsible Person" appointed under the Regulatory Reform (Fire Safety) Order 2005. This is a statutory health and life safety requirement, which is too often disregarded. However, in Principle V as BDM01-10.22, it is suggested that the Regulation 38 Fire Safety Information exchange may be enhanced to become the contracted response of the "Principal Contractor" to the Resilience Strategy initiated by the investor and developed as Principle A, to define the purpose and strengthen the meaning of STICC.

https://www.legislation.gov.uk/uksi/2010/2214/regulation/38

https://www.legislation.gov.uk/uksi/2005/1541/contents

STICC

Strategy, Testing, Inspection, Certification, and Compliance (STICC) is an extension of TICC back in time to the development of the Evacuation, Fire, and Resilience Strategies, discussed in BDM01-10.19 as Principle S and BDM01-10.22 as Principle V. STICC will be further considered in a future BDM title.

Building Manual

The Building Manual is provided at handover under contract to explain the building arrangement and construction to the client's facilities manager. This is often referred to as an "Operations and Maintenance Manual" or "O&M Manual". It is not a statutory requirement, but a deliverable to be specified in the contract that relates directly to the property as an asset. The separation of a high quality Building Manual from an enhanced Regulation 38 Fire Safety Information exchange based in STICC is discussed in BDM01-10.22 as Principle V.

Defining roof or wall

Pitched roofs are conventionally differentiated from walls when they are steeply sloping at less than 70 degrees to the horizontal, and they range in angle through shallow pitched to "flat roof" forms. Consequently, construction may slope up to 30 degrees from the vertical and be considered an external wall, even when made to appear as part of the roof. An example is the "mansard" roof.

Compartmentation

The definition of compartment wall or floor is:

"A fire resisting wall or floor to separate one fire compartment from another."

Cavity

The definition of cavity is:

"A space enclosed by elements of a building (including a suspended ceiling) or contained within an element, but that *is not* a room, cupboard, circulation space, protected shaft, or space within a flue, chute, duct, pipe or conduit."

Cavity categories

There are four categories of cavity construction to consider:

- Cavities concealed by non-fire resisting internal construction [D and F]
- Cavities within roof construction [I]
- Cavities within internal compartment walls and floors [J]
- Cavities within external wall construction [J and K]

Several Principles throughout BDM01 relate to the four categories of cavity, but the [brackets] refer to Principles in which cavities are most obviously discussed.

MMC

The Ministry of Housing, Communities and Local Government Joint Industry Working Group on Modern Methods of Construction provided a definitional framework for MMC to be better understood. The government encouraged MMC terminology, and arguably the frontiers for further investigation, are:

Category 1

Pre-Manufacturing - 3D primary structural systems

Category 2

Pre-Manufacturing - 2D primary structural systems

Category 3

Pre-Manufacturing - Non-systemised structural components

Category 4

Pre-Manufacturing - Additive Manufacturing

Category 5

Pre-Manufacturing - Non-structural assemblies and sub-assemblies

Category 6

Traditional building product led site labour reduction / productivity improvements

Category 7

Site process led site labour reduction / productivity improvements

www.cast-consultancy.com/wp-content/uploads/2019/03/MMC-I-Pad-base_GOVUK-FINAL_SECURE.pdf

However, there is no date at which changing construction methods became discernably "modern", just as there is no moment when "traditional" methods of construction were abandoned. The concept is ahistorical, and lacks discretion in what is a technical progression or regression.

Investors

The initiating investors are not necessarily the eventual building owners or operators when the development is speculative.

"Relevant Persons"

In this document, reference in Principle G to "Relevant Persons" has a wider definition than that in Section 4(3) of the Building Safety Act 2022 concerned with relevant persons in or about "higher-risk buildings", which says:

"For this purpose "relevant persons" means—

(a) residents of higher-risk buildings within the meaning of Part 4,

(b) owners of residential units in such buildings,

(c) persons who are accountable persons within the meaning of Part 4, and

(d) persons upon whom duties are imposed by virtue of paragraph 5B of Schedule 1 to the Building Act 1984 (dutyholders)."

https://www.legislation.gov.uk/ukpga/2022/30/section/4

The definition of "higher-risk buildings" in Part 4 of the Building Safety Act 2022 is explicitly intended to be amended over time, expanding or contracting to define the role of the Building Safety Regulator (BSR). That is a narrow definition.

https://www.legislation.gov.uk/ukpga/2022/30/part/4

Other legislation may similarly impose limited meanings to the legal use of the phrase "Relevant Persons", which may also differ from that in Section 4(3) of the Building Safety Act 2022, as amended. Principle G refers to "Relevant Persons" in relation to the Resilience Strategy, discussed as BDM01-10.7.

FAQs

Frequently Asked Questions.

DIAP and EXAP

Direct Field of Application (DIAP)

Extended Field of Application (EXAP)

EXAP Reports shall be produced to BS EN 15725:2010+C1.2012 *Extended application reports on the fire performance of construction products and building elements*. This standard is currently under review, discussed as BDM01-10.20.

R&D

Research and Development.

15 Index of acronyms

Government

DCSF	Department for Children, Schools and Families
DCMS	Department for Culture, Media and Sport
DDCMS	Department for Digital, Culture, Media and Sport
DETR	Department of the Environment, Transport and the Regions
DfE	Department for Education
DHSC	Department of Health and Social Care
DLUHC	Department for Levelling Up, Housing and Communities
DNH	Department for National Heritage
DSIR	Department of Scientific and Industrial Research
MHCLG	Ministry of Housing, Communities and Local Government
MoW	Ministry of Works
OPSS	Office for Product Safety and Standards

Regulations

CDM	Construction (Design and Management) Regulations 2015
CPD	Construction Products Directive 1989
CPR	Construction Products Regulation 2013
LOLER	Lifting Operations and Lifting Equipment Regulations 1988
PUWER	Provision and Use of Work Equipment Regulations 1998
RR(FS)O	Regulatory Reform (Fire Safety) Order 2005

Reports

RADAR	Research into the Approved Document And its Revisions

Organisations

ABI	Association of British Insurers
ACAI	Association of Consultant Approved Inspectors
ASTM	American Society for Testing and Materials
APHC	Association of Plumbing and Heating Contractors
ASFP	Association for Specialist Fire Protection
ATTMA	Air Tightness Testing and Measurement Association
BAFE	British Approvals for Fire Equipment
BAFSA	British Automatic Fire Sprinkler Association
BASEC	British Approvals Service for Electrical Cables
BCA	Building Control Alliance
BDMA	British Damage Management Association
BESA	Building Engineering Services Association
BESCA	Building Engineering Services Competent Assessment
BFPC	British Fire Prevention Committee
BIBA	British Insurance Brokers' Association
BRAC	Building Regulations Advisory Committee
BRACW	Building Regulations Advisory Committee for Wales

BRE	Building Research Establishment
BSI	British Standards Institution
BSR	Building Safety Regulator
BSRIA	Building Services Research and Information Association
BWF	British Woodworking Federation
CBA	Concrete Block Association
CEN	European Committee for Standardization
CENELEC	European Electrotechnical Committee for Standardization
CFA	Construction Fixings Association
CIBSE	Chartered Institute of Building Service Engineers
CICAIR	Construction Industry Council Approved Inspectors Register
CIoB	Chartered Institute of Building
CLC	Construction Leadership Council
CLG	Contractors Legal Group
CPA	Construction Products Association
CROSS	Collaborative Reporting for Safer Structures
CSA	CSA Group, formerly the Canadian Standards Association
CWCT	Centre for Window and Cladding Technology
DBI	Danish Institute of Fire and Security Technology
EA	Environment Agency
EH	English Heritage
EOTA	European Organisation for Technical Assessment
EPC	Emergency Planning College
FDA	Fire Door Alliance
FOC	Fire Offices' Committee
FIRAS	Warrington Fire
FIS	Finishes and Interiors Sector
FM	Factory Mutual
FMB	Federation of Master Builders
FPA	Fire Protection Association
FSF	Fire Sector Federation
FTSG	Fire Test Study Group
GPDA	Gypsum Products Development Association
GSR	Gas Safe Register
GTI	Grenfell Tower Inquiry
HE	Historic England
HES	Historic Environment Scotland
HS	Historic Scotland
HSE	Health and Safety Executive
IAFSS	International Association for Fire Safety Science
ICC	International Code Council
ICE	Institution of Civil Engineers
IFC	International Fire Consultants
IFE	Institution of Fire Engineers

IFMA	International Facility Management Association
InFiReS	Insurers' Fire Research Strategy
IMunE	Institution of Municipal Engineers
ISO	International Organization for Standardization
IStructE	Institution of Structural Engineers
IWFM	Institute of Workplace and Facilities Management
JCT	Joint Contracts Tribunal
LABC	Local Authority Building Control
LFB	London Fire Brigade
LFC	London Fire Commissioner
LPC	Loss Prevention Council
LPCB	Loss Prevention Certification Board
MA	Museum Association
MCRMA	Metal Cladding and Roofing Manufacturers Association
NAPIT	National Association of Professional Inspectors and Testers
NASC	National Access and Scaffolding Confederation
NFB	National Federation of Builders
NFCC	National Fire Chiefs Council
NFER	National Foundation for Educational Research
NFPA	National Fire Protection Association
NFSN	National Fire Sprinkler Network
NHS	National Health Service
NICEIC	National Inspection Council for Electrical Installation Contracting
NIFRS	Northern Ireland Fire and Rescue Service
NIST	National Institute of Standards and Technology
NSI	National Security Inspectorate
FTEC	Oil Firing Technical Association
PCA	Property Care Association
PFPF	Passive Fire Protection Forum
RCAHMS	Royal Commission on Ancient and Historical Monuments of Scotland
RIBA	Royal Institute of British Architects
RICS	Royal Institution of Chartered Surveyors
SAEMA	Specialist Access Engineering and Maintenance Association
SBF	Scottish Building Federation
SCA	Smoke Control Association
SCOSS	Standing Committee on Structural Safety
SFE	Society of Façade Engineering
SFPE	Society of Fire Protection Engineers
SFRS	Scottish Fire and Rescue Service
SIA	Security Industry Authority
SPAB	Society for the Protection of Ancient Buildings
SSAIB	Security Systems and Alarms Inspection Board
STA	Structural Timber Association
TDUK	Timber Development UK

TRADA	Timber Research and Development Association
TTF	Timber Trade Federation
UCLan	University of Central Lancashire
UKAS	United Kingdom Accreditation Service
UL	Underwriters Laboratories
UWE	University of the West of England
WPA	Wood Protection Association

Buildings

HRB	Higher Risk Building
HRRB	High Risk Residential Building

Construction

ACM	Aluminium Composite Material
ACP	Aluminium Composite Panel
CLT	Cross Laminated Timber
CPS	Concrete Panel System
ETICS	External Thermal Insulation Composite System
FF&E	Furniture, Fixtures and Equipment
IGU	Insulated Glass Unit
IIP	Insulated Infill Panel
LSF	Light Steel Frame
LTF	Light Timber Frame
LVL	Laminated Veneer Lumber
MCM	Metal Composite Material
MMC	Modern Methods of Construction
SIP	Structurally Insulated Panel

Insulation

CF	Cellulose Fibre
CG	Cellular Glass
EPS	Expanded Polystyrene
FS	Fumed Silica
GW	Glass Wool
HF	Hemp Fibre
MW	Mineral Wool
PIR	Polyisocyanurate
PF	Phenolic Foam
PS	Polystyrene
PU	Polyurethane
SHW	Sheep's Wool
SA	Silica Aerogel
SW	Stone Wool
XPS	Extruded Polystyrene
VIP	Vacuum Insulation Panel

Building Services

ACH	Air Change Per Hour
AOV	Automated Opening Vent
ARC	Alarm Receiving Centre
BIPV	Building Integrated Photovoltaic
BMU	Building Maintenance Unit
CFD	Computational Fluid Dynamics
EACIE	Evacuation Alert Control and Indicating Equipment
EAS	Evacuation Alert Systems
EVC	Emergency Voice Communication
FCP	Fire Control Panel
HVAC	Heating, Ventilation and Air Conditioning
IFSS	Integrated Fire Safety System (IFSS)
MEP	Mechanical, Electrical and Plumbing
PAT	Portable Appliance Testing
PDS	Pressure Differential Systems
PV	Photovoltaic
SHEV	Smoke and Heat Exhaust Ventilation

Administrative

AD	Approved Document
AFP	Active Fire Protection
AHJ	Authorities Having Jurisdiction
AoR	Assessment of Risk (LFC)
AVCP	Assessment and Verification of Constancy of Performance
BCP	Business Continuity Plan
BDM	Building Design and Management
BIA	Business Impact Assessment
BIM	Building Information Modelling
BLO	Building Liability Order
BPPP	Business and Property Protection Portal
BREL	Building Regulations England Part L Compliance Report
CAB	Conformity Assessment Body
CAWS	Common Arrangement of Work Sections
CWFT	Classified Without Further Testing
DoP	Declaration of Performance
EAD	European Assessment Document
EIR	Electrical Installation Report
EEIS	Emergency Evacuation Information Sharing
EPD	Environmental Product Declarations
ETAG	European Technical Approval Guidelines
ETA	European Technical Assessment
ERP	Emergency Response Plan
FRA	Fire Risk Assessment
FRAEW	Fire Risk Appraisal of External Walls

FPLS	Fire Performance Labelling Scheme
HBN	Health Building Notes
HTM	Health Technical Memoranda
KPI	Key Performance Indicators
LPS	Loss Prevention Standard
NOG	National Operational Guidance (NFCC)
PAS	Publicly Available Specification
PCSA	Pre-Contract Service Agreement
PEEP	Personal Emergency Evacuation Plan
PIB	Premises Information Box
POE	Post-Occupancy Evaluation
PPS	Police Preferred Specification
RC	Risk Control
SBD	Secured by Design
SIT	System Integration Test
SPZ	Source Protection Zone
QDR	Qualitative Design Review
UKCA	UK Conformity Assessed mark

Testing

DIAP	Direct Field of Application
EXAP	Extended Field of Application
PCS	Pouvoir Calorifique Supérieur

Intelligence

AR	Augmented Reality
BIM	Building Information Modelling
CAD	Computer Aided Design
IT	Information Technology
RFID	Radio-Frequency Identification
QR Codes	Quick Response Codes

16 Index of statutory guidance in England, Scotland, Wales and Northern Ireland

The statutory guidance in the four devolved administrations has the "imprimatur of the government", as the phrase used by Sir Martin Moore-Bick on 8 February 2022 as Day 228 of Phase 2 of the Grenfell Tower Inquiry, page 155 line 13.

https://assets.grenfelltowerinquiry.org.uk/documents/transcript/Transcript%208%20February%202022.pdf

Schedule 1 Requirements in the Building Regulations 2010, as amended by 21 July 2022, are collated as BDM01-11. The Parts of the Requirements provide the shared structure for the different statutory guidance as Approved Documents in England and Wales. A future revision of BDM01 will address the statutory guidance for Scotland, Wales, and Northern Ireland.

England – Approved Documents

https://www.gov.uk/government/collections/approved-documents

(E-AD-A)

Approved Document A: Structure

(2004 as amended 2010 and 2013)

https://www.gov.uk/government/publications/structure-approved-document-a

(E-AD-B)

Approved Document B: Fire safety

https://www.gov.uk/government/publications/fire-safety-approved-document-b

(E-AD-Bv1) Volume 1 – *Dwellings* (2019 as amended 2020 and 2022)

(E-AD-Bv2) Volume 2 – *Buildings other than dwellings* (2019 as amended 2020 and 2022)

(E-AD-C)

Approved Document C: Site preparation and resistance to contaminates and moisture

(2004 as amended 2010 and 2013)

https://www.gov.uk/government/publications/site-preparation-and-resistance-to-contaminates-and-moisture-approved-document-c

(E-AD-D)

Approved Document D: Toxic substances

(1992 as amended 2002, 2010 and 2013)

https://www.gov.uk/government/publications/toxic-substances-approved-document-d

(E-AD-E)

Approved Document E: Resistance to the passage of sound

(2003 as amended 2004, 2010, 2013 and 2015)

https://www.gov.uk/government/publications/resistance-to-sound-approved-document-e

(E-AD-F)

Approved Document F: Ventilation

https://www.gov.uk/government/publications/ventilation-approved-document-f

(E-AD-Fv1) Volume 1 – *Dwellings* (2021)

(E-AD-Fv2) Volume 2 – *Buildings other than dwellings* (2021)

(E-AD-G)

Approved Document G: Sanitation, hot water safety and water efficiency

(2015 as amended 2016)

https://www.gov.uk/government/publications/sanitation-hot-water-safety-and-water-efficiency-approved-document-g

(E-AD-H)

Approved Document H: Drainage and waste disposal

(2015)

https://www.gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h

(E-AD-J)

Approved Document J: Combustion appliances and fuel storage systems

(2010 as amended 2010, 2013 and 2022)

https://www.gov.uk/government/publications/combustion-appliances-and-fuel-storage-systems-approved-document-j

(E-AD-K)

Approved Document K: Protection from falling, collision and impact

(2013)

https://www.gov.uk/government/publications/protection-from-falling-collision-and-impact-approved-document-k

(E-AD-L)

Approved Document L: Conservation of fuel and power

https://www.gov.uk/government/publications/conservation-of-fuel-and-power-approved-document-l

(E-AD-Lv1) Volume 1 – *Dwellings* (2021)

(E-AD-Lv2) Volume 2 – *Buildings other than dwellings* (2021)

(E-AD-M)

Approved Document M: Access to and use of buildings

https://www.gov.uk/government/publications/access-to-and-use-of-buildings-approved-document-m

(E-AD-Mv1) Volume 1 – *Dwellings* (2015 as amended 2016)

(E-AD-Mv2) Volume 2 – *Buildings other than dwellings* (2015 as amended 2020)

(E-AD-O)

Approved Document O: Overheating

(2021)

https://www.gov.uk/government/publications/overheating-approved-document-o

(E-AD-P)

Approved Document P: Electrical safety – Dwellings

(2013)

https://www.gov.uk/government/publications/electrical-safety-approved-document-p

(E-AD-Q)

Approved Document Q: Security – Dwellings

(2015)

https://www.gov.uk/government/publications/security-in-dwellings-approved-document-q

(E-AD-R)

Approved Document R: Infrastructure for electronic communications

https://www.gov.uk/government/publications/infrastructure-for-electronic-communications-approved-document-r

(E-AD-Rv1) Volume 1 – *Physical infrastructure and network connection for new dwellings* (2022)

(E-AD-Rv2) Volume 2 – *Physical infrastructure for high-speed electronic communications networks* (2022)

(E-AD-S)

Approved Document S: Infrastructure for the charging of electric vehicles

(2021)

https://www.gov.uk/government/publications/infrastructure-for-charging-electric-vehicles-approved-document-s

(E-AD-7)

Approved Document 7: Materials and workmanship

(2013 as amended 2018)

https://www.gov.uk/government/publications/material-and-workmanship-approved-document-7

Scotland – Technical Handbooks

https://www.gov.scot/policies/building-standards/monitoring-improving-building-regulations/

To be referred to in a future revision of BDM01

Wales – Approved Documents

https://gov.wales/building-regulations-approved-documents

To be referred to in a future revision of BDM01

Northern Ireland – Technical Booklets

https://www.finance-ni.gov.uk/articles/building-regulations-technical-booklets

To be referred to in a future revision of BDM01

RISCAuthority BDM01 *A to Z of Essential Principles for the protection of buildings* is an orderly recommendation to investors, on behalf of insurers, not to design and build solely down to the 'life safety before collapse' objective on the assumption that the project is a 'common building situation'. Instead, to define and insist upon the resilience their investment requires, beyond statutory guidance or Building Regulations, it calls for resilient construction innovation to improve health and life safety with measures anticipating likely events involving fire and water.

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