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From Prescriptive Standards to Proportional Risk: A Critical Analysis of English Fire Safety Regulation

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Abstract

This paper critically examines the evolution of post-World War II fire safety regulation in England, aiming to identify areas for improvement and enhance understanding of current legislation, including the Building Regulations, the Regulatory Reform (Fire Safety) Order 2005 (FSO), and the Building Safety Act 2022 (BSA). The methodology involved a systematic and critical assessment of 21 key legislative documents from the post-WWII period. Requirements within these documents were rigorously classified and quantified as either prescriptive or performance-based to evaluate temporal shifts, with prescriptive requirements detailing specific actions, while performance-based ones focused on desired outcomes. An initial qualitative review was followed by a detailed analysis, where findings indicate a general trend towards risk-based and performance-based safety regimes in both building design and occupation. While significant fire incidents often led to more prescriptive legislative responses, major legislation such as the Building Act 1984 introduced functional requirements, and the FSO 2005 established a self-compliance risk assessment framework. The BSA 2022 further emphasises "proportionate" safety without clear safety goals for compliance. The concept of proportionality remains unclear, leading to inconsistencies, varied competence, and a critical need for improved data-driven risk assessment to ensure effective and consistent fire safety, particularly for existing buildings.

Key Words: fire safety regulation, prescriptive standards, performance-based design, proportionality, data-driven approach

1. Introduction

Although the number of fires in buildings that occur in the UK has decreased with an 11% reduction recorded between 2014 and 2024[1], there have been significant major fires in recent years, which have led to large losses of life and property. In her review of the English building safety system following the Grenfell Tower fire, Dame Judith Hackitt highlighted that there is a need for improved levels of competence in terms of design, construction, maintenance and inspections for all involved in building safety in order to prevent future major fire incidents[2].

Regulation in fire safety is usually described as either rules-based (often known as “prescriptive”) or performance-based. Rules-based regulation sets out requirements to be followed in order to comply with the law, either in the form of actions or standards[3]. Legislation is formulated by the Government, who wish to set out defined standards for safety. Those enforcing the legislation, such as Fire and Rescue Services, would assume the responsibility of overseeing whether compliance had been achieved. Performance-based regulation sets out goals that need to be achieved in order to meet the objectives of legislation. It is the responsibility of those being regulated to demonstrate how they are meeting the goals. Guidance is often required to provide further detail on the “goals”[3, 4]; however, it requires competencies for its correct application. One of the key requirements of a performance-based approach is for the objectives of the rules to be clearly understood, which can be difficult where performance is measured against the hypothetical likelihood of a fire occurring[4]. Both forms of regulation present challenges due to the stochastic nature of fire incidents. Prescriptive rules can be applied arbitrarily with little understanding of the desired outcome, whilst goal-based rules require expert understanding of associated risks and can lead to inconsistent enforcement of standards [3, 5] . Regulatory regimes are rarely exclusively rules-based or goals-based, but usually involve a hybrid approach where compliance with guidance can act as a proxy for meeting the goals[4].

Fire safety regulation in England in the post-WWII period is generally divided into two common themes: the regulation of new buildings through Building Regulations and the regulation of buildings in occupation. The existing Building Regulations include statutory guidance which sets out the Government's view of how the regulations may be complied with and sets out a benchmark standard for safety in common building situations. Legislation for occupied buildings currently does not have an equivalent form of guidance. In order to ensure that regulatory activity is applied proportionately, it is key for those who are regulating safety to understand what adequate safety means and the thresholds where improvements may be required.

Following the fire at Grenfell Tower, the British Government introduced significant legislation in the form of the Building Safety Act (BSA)[6], which, in addition to existing legislation such as the Regulatory Reform (Fire Safety) Order (FSO) [7]forms a performance-based legislative context for fire safety. This change reflected a trend in legislation towards a performance-based safety regime. The BSA and the FSO are based on the concept of a dutyholder carrying out a risk assessment to consider the likelihood and the consequences of fires in order to achieve the performance objectives for safety outlined in the regulations. In conjunction with this, the BSA specifies that regulators assess buildings "proportionately" ([6], section (s) 3) to mitigate the risk of the spread of fire and structural failure ([6], s.62). This is further qualified in the secondary legislation that accompanies the Act [8] which states that Accountable Persons are required to evaluate proportionate safety measures within their buildings. Recent Government statements have outlined a desire to move "towards a robust, but proportionate, building safety regime"[9]. Although the intention is to move toward proportionate levels of safety, the concept of proportionality has not been defined either in guidance related to the BSA or in its associated regulations. It is unclear whether this proportionate safety regime refers to the likelihood of fire occurring, minimising the consequences and effects of fires that do occur, or assessing and improving existing fire safety measures.

Therefore, the purpose of this paper is to critically examine the post-WW II evolution of fire safety regulation in England, evaluating the systemic shift from rules-based standards, which detail specific mandatory actions, to modern performance-based and risk-based safety regimes that focus on desired outcomes. It specifically investigates how this evolutionary shift has increased the reliance on professional competence and subjective concepts like "proportionality" and compares the legislation for building design with legislation for occupied buildings to highlight gaps in the current regulatory approach, where acceptable safety standards are not clearly defined for persons with duties under these regimes or for those regulating in this area highlighting the need for a data-driven approach to risk regulation.

2. Research methodology

A systematic review of fire safety legislation in England was developed to identify relevant regulations relating to prescriptive and performance-based guidelines, with a focus on the quantification of the level of prescription present in legislation and its changes from the post-WWII (1945) period. The search adopted the UK Government's legislation.gov.uk portal [10] and was based on the term "fire safety" as an inclusion criterion, as well as "buildings". The review identified 21 key pieces of legislation with these terms either in the title or as part of a full-text review. These pieces of legislation established fire safety requirements for either the design of new buildings or safety in occupation in the post-WWII period (1945). This also includes consideration of the existing legislation in place at the beginning of this period, the Public Health Act 1936[11], used for building design. This act is included as it allowed local authorities to create local byelaws about building design in their area and was updated in 1952. The initial stage of the analysis was undertaken using NotebookLM[12], a generative AI research tool that helps to interrogate only specific sources uploaded to a workbook. The analysis aimed to produce

an initial qualitative review to examine each piece of legislation and the fire safety requirements detailed within. Each piece of legislation was analysed in terms of whether fire safety requirements in each source set specific rules or more general goals. The level of prescription was evaluated for requirements that had a direct impact on the fire safety of a building in terms of building design features, management processes or the requirement for certification of a premises for legislative compliance.
Table 1 provides an overview of the definitions and characteristics that were used for this analysis in terms of rules-based and goals-based legislations, with their definition and key characteristics in terms of compliance, language, function and enforcement.

Table 1: Definitions of Rules-Based and Performance-Based Legislation

Legislation Type	Definition	Key Characteristics
Rules-Based	Requires compliance by detailing specific actions, methods, or processes.	*Compliance:* Achieved by strictly following explicit, detailed instructions (e.g., for materials or construction methods). *Language:* Indicated by mandatory phrases like "must," "shall," or "is required to be". *Function:* Often found in "Deemed-to-satisfy" provisions, offering a specific solution to achieve a broader requirement. *Enforcement:* regulators check compliance with the rules
P**erformance**-Based (Requirements/goals-Based Design)	Specifies a desired outcome or level of performance, allowing flexibility in how that outcome is achieved.	*Compliance:* Demonstrated by achieving the stated objective, often through risk assessment, engineering analysis, or testing. *Language:* Indicated by phrases focusing on the objective, such as "suitable," "appropriate," or "where necessary". *Function:* Defines what outcome must be achieved through different approaches and establishes a risk-based safety regime. *Enforcement:* Regulators assess whether the regulatee's actions meet the requirements of the goals

Using the definitions in Table 1 and the taxonomy in Table 2 as the basis of the research analysis, a set of questions was used by the AI to interrogate the pieces of legislation to highlight rules-based and performance-based requirements. Legislation in England can be complex, as it consists of different types of law which are referred to in different ways, so the definitions outline on the UK Government's Legisltion.uk [13] website were used for consistency. Following the initial qualitative review of legislation by the AI, a manual check of the results was carried out by the researchers to ensure the results and check for agreement.

Table 2: Summary of taxonomy used for analysing legislation

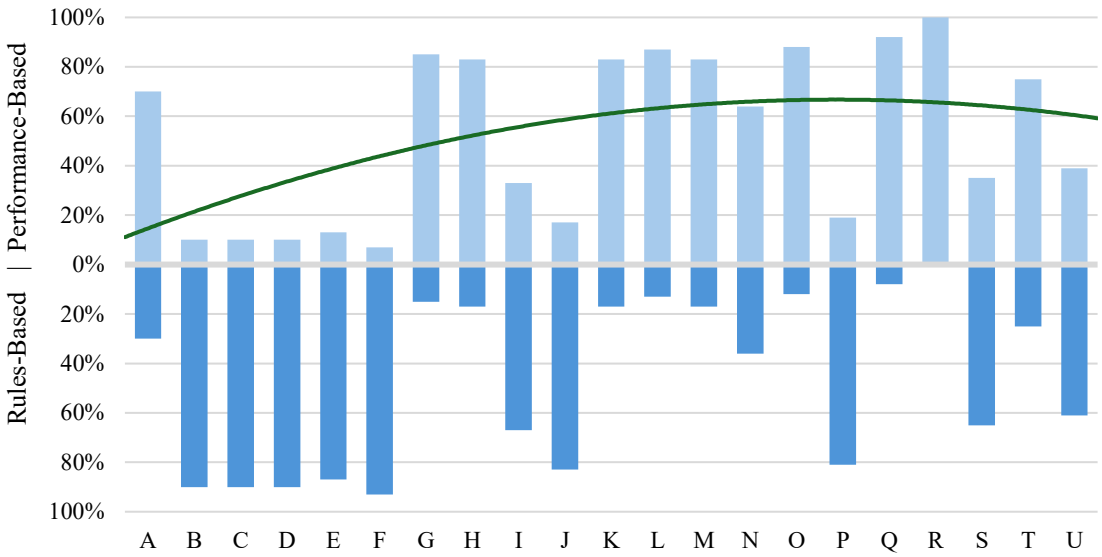
Feature	Rules-based Requirements	Performance-Based Requirements

Goal	Compliance via replication of a standard	Compliance via achievement of a safety level
Level of Flexibility	Low: Instructions must be followed strictly	High: Allows for innovative or non-standard designs
Linguistic Cues	"Must", "Shall", "Required"	"Suitable", "Appropriate", "Necessary"
Risk Ownership	Often rests with the regulator who sets the standard.	Rests with the dutyholder who must prove the design is safe
Key Challenge	Can inhibit innovative design and may not address specific risks	Relies heavily on competence and the subjective concept of proportionality

The analysis highlighted that rules-based requirements could be categorised as either highly prescriptive, outlining specific measures and requirements, or a hybrid, where specific mandatory requirements could be varied according to context. The sources were reviewed thematically in terms of whether they applied to building design or the regulation of occupied buildings, with outputs initially focusing on all relevant legislation to identify if there were any overarching trends during the examined period. Whilst the analysis aimed to be scientific in its approach to assessing regulations, it should be noted that some interpretation was necessary. Further analysis was then undertaken on themes including legislative design requirements, safety in occupation and regulation following significant fire events. The analysis aimed to quantify each source in terms of the number of requirements for fire safety that were rules-based or performance-based to highlight whether there had been a change in how the UK Government approached fire safety legislation. The analysis also focused on highlighting whether there has been any difference in the approach to regulating building design and building safety for occupied buildings. It is acknowledged that in some cases, specific individual requirements, such as certification, may have a greater level of prescription than others. This may result in consequences where the application becomes or is perceived as being more rules-based than the original intent of the legislation[14].

3. Overview of the Evolution of Fire Safety Regulations 1945-2025 in England

Table 3 summarises the analysis of fire safety regulations, highlighting the number of rules-based and performance-based requirements found in the examined legislation. The percentages in Table 3 represent the level of rules-based or performance-based regulation calculated as a percentage of the number of rules-based or performance-based requirements over the total requirements for each specific piece of legislation. Fire safety regulation in England has been subject to a gradual evolution from rules-based standards to performance-based design and risk assessment[14]. Figure 1 shows the timeline for all legislation in the examined years. The analysis highlights that there has been a general trend from rules-based requirements towards a more risk or performance-based form of regulation.



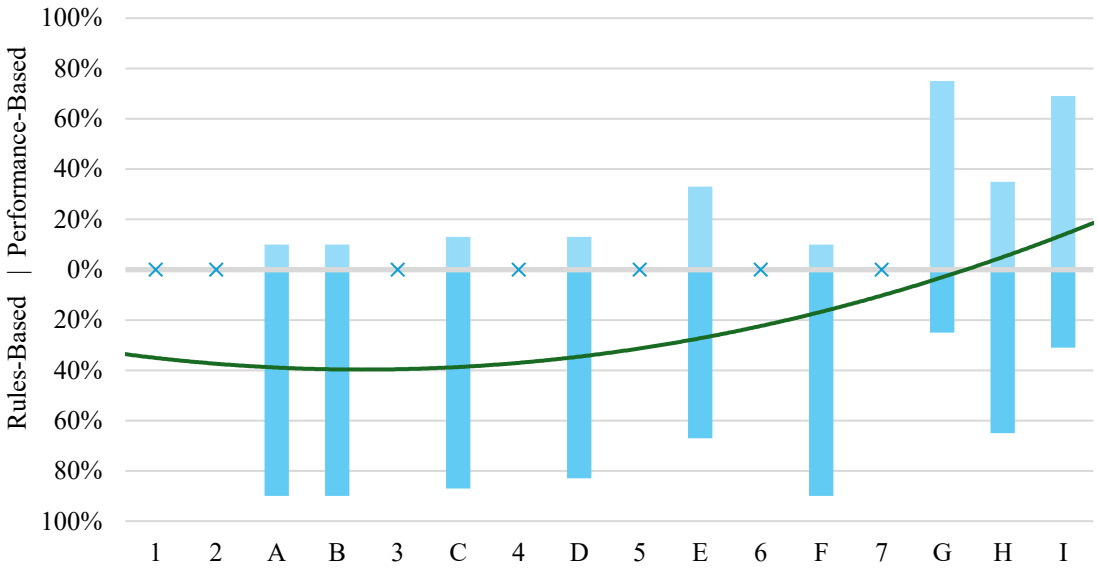
A. Public Health Act 1936, **B.** Factories Act 1961, **C.** Offices, Shops and Railway Premises Act 1963, **D.** The Building Regulations 1965, **E.** Fire Precautions Act 1971, **F.** The Building Regulations 1976, **G.** The Building Act 1984, **H.** Building Regulations 1985, **I.** Fire Safety and Places of Sport Act 1987, **J.** Fire Precautions (Sub-surface Railway Stations) Regulations 1989, **K.** Building Regulations 1991, **L.** Fire Precautions (Workplace) Regulations 1997, **M.** Building Regulations 2000, **N.** Housing Act 2004, **O.** Regulatory Reform (Fire Safety) Order 2005, **P.** Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009, **Q.** Building Regulations 2010, **R.** Building Safety Act 2022, **S.** The Higher-Risk Buildings (Management of Safety Risks etc) (England) Regulations 2023, **T.** Building Regulations 2010 - including 2023 amendments, **U.** The Building (Higher-Risk Buildings Procedures) (England) Regulations 2023

Figure 1 Evolution of fire safety legislation in England

While there is a general trend towards performance-based regulation, there are also regulations that represent a reaction to major fire incidents. Figure 2 presents legislation introduced after disasters, which tends to be rules-based. These fires may not have been the only reason for legislative changes[14]; however, it was found that they introduced a greater degree of conservatism in the formulation of regulations [15] as highlighted in Figure 2, which shows that prior to the fire at Grenfell Tower in 2017, incidents causing a large number of fatalities were followed by more prescriptive regulation. Examples of this include the introduction of certification of sports stadia following the Bradford City football stadium fire in 1985 [16] and more defined standards for sub-surface railway stations, following the King's Cross fire in 1987[17]. These regulations tend to require some form of regulatory certification, highlighting the trend for policymakers to become more risk-averse in order to avoid future disasters[18]. This is still the case in the most recent legislation following on from the Grenfell Tower fire in 2017, which is mainly performance-based but shows a move towards prescriptive requirements compared to other recent legislation. Again, this is due to the legislation, including aspects such as regulatory "gateways" and provisions for a building assessment certificate for occupied premises[6].

Table 3: Results of analysis for the level of rules-based and performance-based regulations in English fire safety legislation post-WWII

Title	Scope	Number of Rules-Based Regulations	Number of Performance-Based Regulations	Total Number of Regulations	Rules-Based [%]	Performance-Based [%]
Public Health Act 1936	Design/Occupation	2	1	3	33	67
Factories Act 1961	Occupation	17	2	19	90	10
Offices, Shops and Railway Premises Act 1963	Occupation	9	1	10	90	10
The Building Regulations 1965	Design	14	2	16	88	12
Fire Precautions Act 1971	Occupation	251	39	290	87	13
The Building Regulations 1976	Design	20	3	23	87	13
The Building Act 1984	Design	0	8	8	0	100
Building Regulations 1985	Design	1	5	6	17	83
Fire Safety and Places of Sport Act 1987	Occupation	48	24	72	67	33
Fire Precautions (Sub-surface Railway Stations) Regulations 1989	Occupation	64	13	77	83	17
Building Regulations 1991	Design	1	5	6	17	83
Fire Precautions (Workplace) Regulations 1997	Occupation	2	15	17	13	87
Building Regulations 2000	Design	1	5	6	17	83
Housing Act 2004	Occupation	5	9	14	36	64
Regulatory Reform (Fire Safety) Order 2005	Occupation	6	52	58	12	88
Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009	Design	30	7	37	81	19
Building Regulations 2010	Design	1	5	6	8	92
Building Safety Act 2022	Design/Occupation	0	24	24	0	100
The Higher-Risk Buildings (Management of Safety Risks etc) (England) Regulations 2023	Occupation	100	53	153	65	35
Building Regulations 2010 - including 2023 amendments	Design	2	6	8	25	75
The Building (Higher-Risk Buildings Procedures) (England) Regulations 2023	Design	27	17	44	61	39



1. Eastwood Mill Fire, Keighley 1956, **2.** William Henderson and Sons department store, Liverpool 1960, **3.** Rose and Crown Fire, Safron Walden 1969, **4.** Summerland Fire, Isle of Man 1973, **5.** Bradford City Football Ground Fire, 1985, **6.** King's Cross Underground Fire, London, 1987, **7.** Grenfell Tower Fire, London 2017

A. Factories Act 1961, **B.** Offices, Shops and Railway Premises Act 1963, **C.** Fire Precautions Act 1971, **D.** The Building Regulations 1976, **E.** Fire Safety and Places of Sport Act 1987, **F.** Fire Precautions (Sub-surface Railway Stations) Regulations 1989, **G.** Building Safety Act 2022, **H.** The Higher-Risk Buildings (Management of Safety Risks etc) (England) Regulations, **I.** Building Regulations 2010- including 2023 amendments

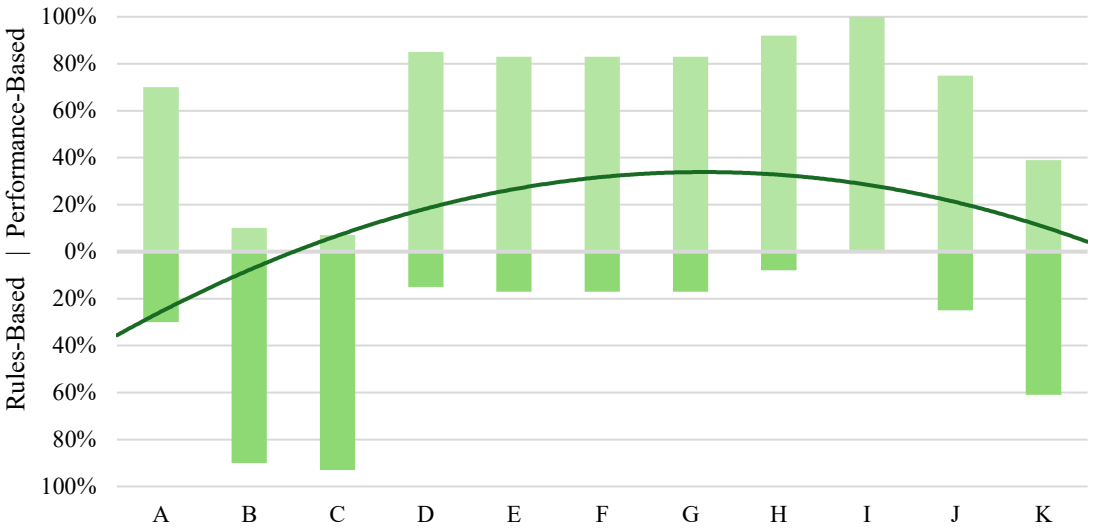
Figure 2 Evolution of fire safety regulations and major fire incidents in England

4. Fire safety design and the management of occupied buildings

4.1 Fire safety legislation for building design

Building design guidance in the post-WWII period followed on from the post-war building studies on the fire grading of buildings[19, 20]. In 1952, the results of the post-war building studies led to updated requirements in the Public Health Act [11] to promote freedom in building design and introduce functional requirements[21]. The performance-based nature of these requirements was introduced by the need to build quickly following the war, and to replace housing that was lost to bombing[14]. After an of relatively performance-based regulation, the building regulations became increasingly rules-based (Figure 3). The first national Building Regulations [22] in England, detailed specific building design requirements that formed part of the regulations themselves and were updated and extended in 1976[23]. The analysis revealed that these regulations were mostly rules-based in nature; some of the requirements have elements of performance-based design in what are stated as "deemed-to-satisfy requirements", which imply a prescriptive level of performance but allow some flexibility in the implementation. However, the lack of an alternative to following the regulations meant the application of the regulations became prescriptive and did not allow for engineers and architects to engage in innovative design. The 1965 and 1976 Building Regulations [22, 23] focused on the implementation of

prescriptive rules, rather than requiring designers to understand whether they were designing safe buildings for occupants[5].



A. Public Health Act 1936, **B.** The Building Regulations 1965, **C.** The Building Regulations 1976, **D.** The Building Act 1984, **E.** Building Regulations 1985, **F.** Building Regulations 1991, **G.** Building Regulations 2000, **H.** Building Regulations 2010, **I.** Building Safety Act 2022, **J.** Building Regulations 2010 - including 2023 amendments, **K.** The Building (Higher-Risk Buildings Procedures) (England) Regulations 2023

Figure 3 Evolution of fire safety regulations for building design in England

The Building Act [24] consolidated previous building enactments and defined a legal framework which enabled the creation of new Building Regulations. It moved from defining rules-based measures to outlining performance-based 'functional requirements' for building design to achieve These functional requirements establish objectives in terms of the design of safe means of escape for building occupants, limiting interior and exterior fire spread and providing access and facilities for firefighting purposes. Whilst these functional requirements created a flexible regime, they also led to uncertainty when it came to designing common buildings. To alleviate some of this uncertainty, the Building Act [24] enabled the Secretary of State to issue approved guidance, named as Approved Documents, which offered the Government's opinion on how the functional requirements of the regulations could be achieved in common building situations [25] and act as a "safe harbour" of regulation[4]. The Approved Documents, revised over the years, are not prescriptive, meaning that their recommendations do not have to be followed, and designers are free to use other means to satisfy the functional requirements. However, following the guidance in an Approved Document implies that designers would "tend to negative liability" ([24], article (a).7) in any potential future civil or criminal proceedings, should a fire occur in the building. Tending to "negative liability" means that designers and constructors would not automatically be held accountable for a fire if they adopt all reasonable steps to follow the Approved Documents or can prove that it was not reasonably practicable for them to do so.

However, the guidance in the Approved Document B (ADB) for fire safety [26] does not outline requirements for the management of buildings once occupied, other than the basic assumption that they will be properly managed. The publication of the Approved Documents did not preclude designers from using other methods to design buildings as long as they met the objectives of the functional requirements. This also led to instances in which, although the regulations became performance-based,

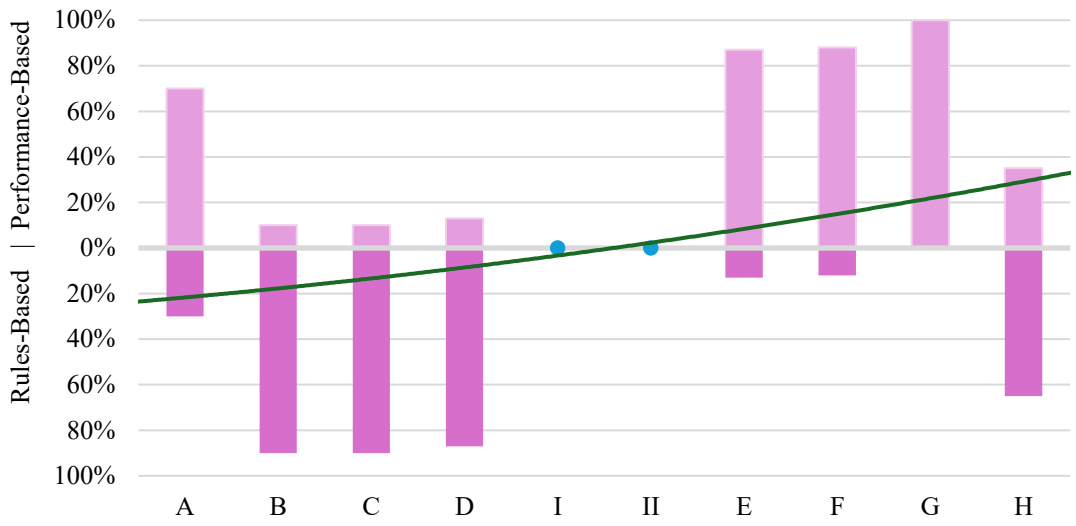
their implementation was considered similar to the "deemed to satisfy" requirements, with more prescriptive iterations of the Building Regulations[22, 23]. The perception that the Approved Documents were a prescriptive approach to design was in part due to their guidance offering a more cautious approach to the approvals process [27] and also because they allowed those without sufficient expertise and resources to engage in a performance-based regime and comply with the regulations[28]. The introduction of functional requirements paved the way for the use of fire engineering or performance-based design in the 1990s, as highlighted in the trend in legislation shown in Figure 3. Performance-based designs of buildings determine the applications of the functional requirements of the building regulations by using knowledge gained from research and scientific understanding of fire, and introducing the use of risk analysis and computational modelling[29]. This allowed for a more flexible approach to design, which could supersede the deterministic solutions given in the Approved Documents. The performance-based approach was then standardised by the introduction of British Standard 7974[30], creating a framework for its use in the design phase. The introduction of performance-based design implied that the competence of those using it became an increasing focus.

The wider use of performance-based design has led to different understandings for the professionals working in the field, with fire engineers and regulators having differing perceptions of acceptable levels of safety[27]. Variations in competence and understanding of the fire safety objectives of buildings can lead to decisions based on different levels of risk perception. Fire engineers may tend towards "remedial engineering", where their input is used to justify an architectural design and ensure that it meets the threshold of Building Regulations approval. Conversely, Fire Authorities may tend towards a more cautious approach, which favours adherence to established design codes[31]. Whilst life safety should always be considered as the main design objective, the Inquiry into the fire at Grenfell Tower in London in 2017 [32] and the "Building a Safer Future" report [2] highlighted the use of fire engineering to "value engineer" building design based on financial considerations. Legislation introduced following the fire in 2017 shows a reaction to the disaster by introducing elements of prescription, such as the banning of combustible items on facades and the introduction of specific dutyholder roles in building design and construction, included in amendments to the building regulations[33].

A significant concern is the reliance on design standards, such as ADB, to serve as a proxy for compliance with the building regulations in all circumstances and as a substitute for a comprehensive understanding of fire engineering and a building's inherent safety characteristics. As a consequence, rather than validating safety through fundamental fire engineering principles, designers and regulators often implement variations based solely on the internal logic or specific allowances of the guidance documents[34]. The content of ADB is treated as the goals of the performance-based legislation rather than an evolved, Governmental interpretation of safety. This understanding is further exacerbated by the lack of a clear definition of where ADB is applicable. The document outlines that it should be applied in "common building situations" with reference to the Manual to the Building Regulations [25] without further explanation. This means that fire engineering practice often prioritizes demonstrating equivalent safety standards to those outlined in ADB rather than demonstrating how a design meets the functional requirements.

4.2 Fire safety legislation for occupied buildings

Figure 4 shows how prescriptive requirements changed over time, with the inclusion of a gap from 1971 to 1997 to highlight that the move towards a performance-based regulation occurred over a longer period than for building design. Figure 4 highlights regulations for general buildings and excludes disaster-based regulations from the 1980s, which targeted specific premises types, such as sports grounds, in the Fire Safety and Safety of Places of Sport Act[16], and sub-surface railway stations included in The Fire Precautions (Sub-surface Railway Stations) Regulations[17].



I-II. Gaps in regulations in 1980s and 1990s
A. Public Health Act 1936, **B.** Factories Act 1961, **C.** Offices, Shops and Railway Premises Act 1963, **D.** Fire Precautions Act 1971, **E.** Fire Precautions (Workplace) Regulations 1997, **F.** Regulatory Reform (Fire Safety) Order 2005, **G.** Building Safety Act 2022, **H.** The Higher-Risk Buildings (Management of Safety Risks etc) (England) Regulations

Figure 4 Evolution of fire safety regulations on occupational guidance in England

As noted above, the Factories Act[35], and the Offices, Shops and Railway Premises Act [36] required the certification of relevant premises by a regulating authority. The Fire Precautions Act (FPA) [37]consolidated the previous fire safety legislation and attributed responsibility to Fire Authorities to define specific standards of safety[14]. Fire authorities were viewed as the most appropriate regulator due to their experience of fire and its consequences from attending real incidents[38]. The FPA introduced fire certificates, which were issued by the fire authority that inspected premises to determine reasonable measures of safety. Certificates specified requirements for safety within designated premises, including maintaining escape routes, ensuring fire safety measures are adequate, providing fire safety training for employees, limiting occupancy, and establishing other fire-related precautions. Under the certification system, fire safety standards were permanent and fixed in the fire certificate. These standards could not be updated or changed without an official reassessment by the enforcing authorities, resulting in a rigid management process that lacked flexibility. Only premises types that were designated in the legislation, such as sleeping accommodation, institutions providing treatment or care, entertainment, recreation, instruction and teaching, training, and research, were considered.

The requirement for premises to be designated prevented Fire Authorities from addressing new hazards that may have emerged in other building types. The FPA was enforced via routine inspections by the Fire Authority to ensure standards had been maintained. However, this system was considered inflexible as it was not focused on the management of risk in premises, as Fire Service inspections were based on whether the conditions in the certificate were upheld. An offence was considered to have been committed if requirements in a fire certificate were not being maintained [37] (a.7). The FPA placed the regulatory onus on those enforcing the regulations, with the fire authority setting the standards. Guidance in the application of the FPA was written for the fire authority, with only a small section given over to advice for those occupying buildings[39].

The gradual adoption of performance-based design to meet the building regulations highlighted limitations with the prescriptive oversight of buildings when occupied. The Fire Precautions

(Workplace) Regulations (FPWR) [40]first introduced the requirement to risk assess premises in England. These regulations were created to implement European Council directives on workplace safety[41]. Initially, the FPWR required employers in buildings not covered by the FPA to carry out a suitable and sufficient fire risk assessment, actively identify fire hazards, people at risk, and apply appropriate preventative and protective measures ([40], a.4-6). The exemption of premises with a fire certificate meant that the overlap between the FPA and the FPWR was difficult to understand for the layperson, with it being described as "bewildering and burdensome" to business[42].

The FSO represented the biggest change in fire safety regulation for over 30 years [43] and the change to performance-based regulation for all buildings (with the exception of domestic premises), as highlighted in Figure 4. The FSO consolidated the previous fire safety legislation for prescriptive certification and risk assessment into a regime where the onus on setting safety standards moved from the enforcing authority towards those managing buildings.

Under the FSO, Responsible Persons are given a duty to carry out fire risk assessments of their premises to determine whether suitable measures are in place. A "Responsible Person" was defined as the employer, if it is for a workplace under their control, for the person who is responsible for the building for a business in other non-domestic premises, and the owners of the other premises ([7], a.3). Whilst the FPA relied on FRSs to detail fire safety standards in a fire certificate, the FSO focused on self-compliance, with less emphasis on FRS inspections to assess whether standards were being maintained. Responsible Persons were now required to undertake a "suitable and sufficient" ([7], a.9) risk assessment of fire safety measures in their premises and "take such general fire precautions as will ensure, so far as reasonably practicable, the safety of his employees" ([7], a.8).

Where a Responsible Person does not feel competent to risk assess their premises, they may employ a fire risk assessor ([7], a.23) as long as they have "sufficient training and knowledge or experience" ([7], a.23). This approach is reliant upon the Responsible Person [7] understanding the term "suitable and sufficient" and their own ability to assess this risk[44]. This led to inconsistencies in the standards applied in different building types, as risk assessment was dependent upon the skills of the individual risk assessor. Whilst registration schemes for fire risk assessors are available, there was no requirement for registration until the Government accepted the recommendations of the Grenfell Tower Inquiry Phase 2 report[32], which determined the need for mandatory accreditation to certify the competence of fire risk assessors.

Fire and Rescue Authorities have the duty to enforce the FSO ([7], a.24); however, the FSO allows enforcing authorities to direct their resources towards buildings in which there is a perception of a higher risk to life. Guidance in assisting the evaluation of premises was published by the Chief Fire Officers Association in the Fire Safety Guidance Audit Form V4-3 [45] which defined a framework for auditing relevant premises and scoring the risks. This guidance was based on the Government's Fire Services Emergency Cover Toolkit [46] which used historical fire incident data to help evaluate risk in the areas that fire services served.

The audit process is based upon assessing compliance with a.8-23 and a.38 of the FSO and assigning a score to each article. The scoring process is weighted towards the perceived effect of each article on the risk within the building. For example, the absence of suitable fire doors to keep emergency routes and exits safe in accordance with a.14 of the FSO may score more highly than a lack of fire extinguishers in accordance with a.13. These scores are also weighted in terms of the occupancy, with higher risk buildings, such as care homes, having higher values for scores than offices, due to the risk that poor safety management would have on people in the building. This system relies on the competence of the regulator to understand the interaction of the safety measures present and the risk within the premises[47]. This model for assessing building risk was not issued or overseen by the Government, with the standard for safety being outlined in guidance published by an industry representative body for the fire services. The audit scoring process is based on the Enforcement Management Model [48]

formulated by the Health and Safety Executive for use in their regulatory field. The Enforcement Management Model uses risk gap analysis to highlight any shortfalls in safety features and provides a methodology for quantifying the reduction in risk to as low as reasonably practicable. However, in the context of fire, this concept is not well-developed, with the quantification of what is "safe enough" being dependent upon individual perception of risk[49].

Risk assessments tend to rely on the concept that if a building meets the same standard as it was designed to, then the safety level should be assured [44] which can lead to qualitative assessments not based on data-informed decisions. Without clear descriptions of safety goals, regulators subsequently encounter difficulty in determining whether a building was sufficiently safe if it did not meet with or vary from current standards in areas such as protection to the means of escape or fire-resisting construction[5]. Assurances of safety refer to standards outlined in guidance, such as ADB, where a regulator or risk assessor may not have an adequate understanding of the underlying safety principles[34]. This can lead to situations where fire safety activity aims to meet the requirements of rules-based guidance rather than to understand whether risk mitigation measures are adequate to assure the safety of occupants[50].

The key difference in legislation for occupied buildings is that detailed guidance for an adequate level of safety that should be provided was not part of the original regulatory regime. The status of guidance for the FSO was updated with the introduction of the Fire Safety Act 2021 [51] so that a failure to comply with the guidance can be used as evidence that the law has been contravened. However, this FSO guidance differs from ADB as it sets out a framework for risk assessing various building types, and it does not define specific rules which can be complied with. The concept of risk assessment is specified in terms of identifying hazards, risks and those who may be affected by them[4], without determining the acceptable level of safety. It should also be noted that in the 20 years since the enactment of the FSO, its guidance has not been updated to reflect recent fire risk based on fire incident data.

5. Concepts of proportionality

Changes in fire safety regulations for occupied buildings in more recent times have supported a move away from regulators enforcing specific rules. The introduction of self-compliance regimes reliant on the assessment of risk in buildings are based on a "suitable and sufficient" or "proportionate" approach to mitigating hazards.

Although the Grenfell Tower fire in 2017 increased scrutiny on the concept of performance-based design, the legislation introduced following the fire incident continued the trend towards risk-based regulation[52], albeit in a hybrid approach which involved the issuing of a certificate by the regulator to confirm a satisfactory standard of safety had been achieved in occupied buildings. The BSA defines a regulatory regime which is based on preparing a form of risk assessment known as a safety case report for safety in higher-risk buildings. The Building Safety Regulator is given the duties to carry out its regulatory activities in a proportionate and consistent way that is targeted at cases where action is needed (BSA, a.3).

In formulating regulation, Governmental departments carry out cost-benefit analysis for impacts, which considers the impact on the whole of society and identifies the greatest benefit for a proportionate impact[53, 54]. This move towards the concept of proportionality also reflects the Government's wider Better Regulation Framework[55], which states that there must "be sufficient evidence that any identified risk of not regulating is credible and real". However, an equivalent methodology to that published for establishing whether legislation is cost-beneficial for society [54] is not available for regulators to apply to individual buildings. In order for regulators to apply legislation proportionately to reduce risk to a societally acceptable level, there needs to be an understanding of tolerable risk to individual institutions, and what this means in terms of a cost-benefit ratio[56]. This Governmental

agenda was also present when the FSO was introduced, where the policy direction aimed to reduce the regulatory burden on businesses, as outlined in the Legislative and Regulatory Reform Act[57]. As part of these regulations, Government Ministers were able to issue guidance to regulators on how to exercise their regulatory functions. The Regulators' Code details that regulators "should avoid imposing unnecessary regulatory burdens through their regulatory activities"[58]. The Enforcement Management Model [48] highlighted in the previous section, supports a process of assessing whether safety measures are proportionate. However, this can be difficult to apply in the context of fire, as its application is dependent upon the use of probabilities to assess whether the implementation of additional safety measures is seen as in the terms of the Enforcement Management Model as "grossly disproportionate". The BSA and the FSO create a system where the Building Safety Regulator and FRSs regulate fire safety in occupied buildings based on the risk to occupants. However, a key obstacle is that there are frequent references to concepts such as "proportionate" assessments ([8], regulation (r) 4), and "so far as reasonably practicable" ([7], a.8). These terms can be highly context-dependent in relation to building use and occupancy as well as the competencies and experiences of those responsible for risk identification, assessment and mitigation. Upgrading buildings to meet modern standards may represent a complex risk-assessment approach, potentially leading to a situation where the benefits of improving safety measures may be outweighed by the costs[49]. There is a need for a greater understanding of the concept of proportionality amongst building designers, risk assessors and regulators to ensure that fire safety measures are included where necessary and that an accurate assessment of risk is determined. One way of gaining greater clarity is to investigate areas of fire safety where data are used to support an understanding of building risk.

5.1 Case Study of safety measures in care homes

Clear communication of the goals of legislation is essential to avoid unnecessary regulatory activity[4]. When legislative goals are not clearly articulated, uncertainties can arise for both regulators and those subject to regulatory duties[28]. This lack of clarity can lead to an inconsistent application and interpretation of regulations, which can result in either a continued reliance on prescriptive implementation of previous standards or in the incomplete adoption of new regulatory requirements.

The application of fire safety in care homes illustrates how a lack of defined goals can lead to the potential for inconsistent implementation of the FSO. The agenda to reduce regulatory burden on business is difficult to interpret in terms of the requirements that were defined in the FSO itself, which gives Responsible Persons a duty to apply principles of prevention ([7], a.10). These principles of prevention outline that general fire precautions should aim to avoid, evaluate or reduce risks, implement measures that adapt to technical progress and prioritise collective protective measures. These duties to adapt and progress rely upon the Responsible Person's understanding of the risks in their premises and their awareness of changes in fire safety standards and where they may need to implement them. The British Standard for fire detection and fire alarm systems for buildings [59] was updated in 2013 following the Rose Park Care Home fire in Scotland[60]. Although this fire was in Scotland, the findings from the incident were applicable throughout the UK. The update to the standard introduced a requirement for addressable alarm systems in residential care homes. This update would aid responsible persons in identifying the location of a fire more quickly and beginning effective evacuation procedures. This may mean that Responsible Persons who are aware of the changes should adapt and update their fire detection and alarm systems. This requirement creates tension for regulators applying the principles of the Regulators' Code [58] as they would need to demonstrate that such an upgrade to existing systems was proportionate to the increase in safety for occupants of buildings. This is highlighted in a review of care home premises by the London Fire Brigade in 2019 [61] which found that less than half of all premises inspected did not have a suitable and sufficient assessment of the risks present[62].

An update to ADB was published in 2024, which introduced a requirement for all new care homes to be protected by sprinklers. A regulatory impact assessment was published in order to explain the change; however, this is mainly focused on the additional costs of installation, and did not consider the management benefits[63]. Providing means of escape for residents in care homes is reliant on management procedures and staffing, which is not accounted for in ADB. Management does not form part of the guidance to meet the functional requirements. However, as buildings move towards a risk-based approach in occupation, as introduced by the FSO, the difference between the Approved Documents and the requirements for safety management in buildings becomes more apparent.

In residential care homes, the risks of the evacuation of residents requiring assistance in a progressive horizontal evacuation strategy may either be managed through increased staffing or through additional fire safety measures, such as upgraded fire detection and alarm systems or the installation of sprinklers [64] with both sets of measures potentially needed. The FSO guide for care homes [64] states that all areas of a building should be able to be evacuated as part of a progressive horizontal evacuation strategy in two and a half minutes. Where this is not possible, then additional measures may be required, such as automatic water suppression or additional staff. Whilst initially it may seem more costly to install additional safety measures, it may be more proportionate for an FRS to request this than to require additional staff to be able to carry out a safe evacuation in the event of a fire. The requirements for Responsible Persons to demonstrate how their buildings are safely managed and that people can safely evacuate the part of the building in which a fire occurs have similarities with a fire engineered assessment of evacuation. However, without a clear definition of regulatory goals or what constitutes "safe enough," safety standards remain uncertain, leading to inconsistency and ambiguity for both regulators and those responsible for managing building fire risks.

5.2 Case Study of Safety Measures in High-Rise Blocks of Flats

High-rise residential buildings provide a further illustration of the need to understand proportionality in terms of where additional fire safety measures may be required. The BSA requires an accountable person to prepare a safety case report, which details their assessment of the parts of a high-rise building for which they are responsible, for the building safety risks of fire spread and structural collapse ([6], s. 83 and s. 85). The Accountable person subsequently has a duty to take all reasonable steps to prevent building safety risks from occurring and to reduce the severity of them if they do occur ([6], s.84). These steps may be clear when applied to new buildings; however, difficulties arise when applied to premises built to previous building standards. Buildings refurbished over the years may present safety features, such as permanently vents required in the 1960s[65], potentially altered in order to meet modern standards for the conservation of fuel and power. Regulation 4(3) of the building regulations states the requirement that where building work is carried out, it either complies with the modern requirements of the building regulations or is left in no worse a condition than before the work commenced[66]. This "non-worsening" clause of the Building Regulations is counter to the continuous improvement aspects of the BSA [6] and FSO[57]. Where buildings are being upgraded or refurbished, there is no mechanism under the building regulations to require improvement, shifting the responsibilities to those regulating in-occupation safety to enforce higher standards. For buildings where permanent vents may have been closed and where there is no evidence of whether the smoke control features of the escape routes will mitigate a building safety risk of fire spread, regulators need to evaluate proportionality to highlight whether and what additional measures are required. An example scenario may involve a building where there is a single mean of escape and no facilities to assist the evacuation of disabled people. Smoke is likely to spread on the staircase [67] or natural ventilation may not be effective or provide an adequate means of maintaining a clear escape route[68]. Both those assessing the building and regulators need to be able to understand where existing conditions represent unacceptable risk and where improvements are required. It may not be reasonable or proportionate to expect the building to be improved and

updated to modern standards; however, it may be reasonable to require the installation of additional fire safety measures, such as sprinklers or advanced smoke control systems, to safeguard residents in the event of a fire.

6. Data-driven and risk-informed decision making

Guidance for performance-based design may provide an understanding of how to interpret the application of risk-based assessment of buildings. As part of the BS 7974 series of guidance for fire engineering, PD 7974 Part 7 [69] is the only current fire safety guidance which details an approach that uses fire incident data in the probabilistic risk assessment of building designs. It introduces guidance on specific fire statistical variables, such as the probability of fires occurring, fire growth rates and fire load density in a range of premises types, including residential or office buildings, and details methodologies to assist fire engineers in demonstrating that their designs meet the required design criteria for building approval regimes. Prior to its latest update, PD 7974-7 [69] presented fire statistical data that were over 50 years old[70]. This implied that designs may be based on data about fire frequency and fire size, not representative of the likelihood and consequences of building fires[1]. A failure to reference and adopt relevant recent data to inform decision-making can also imply that fire engineered designs could not consider the real performance of buildings subjected to fires and the effectiveness of safety measures, as well as the influence of emerging fire risks, such as the increased use of lithium-ion batteries with a different fire load than those outlined in standards such as ADB. A continuous assessment of the fire statistical dataset could support a comprehensive understanding of fire risk[70]. Moreover, changes in social behaviour are able to influence fire occurrence.

Regulating buildings can also be challenging due to safety measures and management actions becoming less effective over time[71]. Fire and enforcement data provide a context in which it may be possible to analyse the effectiveness of safety and management measures[44]. PD 7974-7 [69] outlines factors that influence the choice of safety measures in a building design, including societal requirements, such as life safety or environmental protection, and society's perception of risk[49]. The context of enforcement actions needs to be evaluated in terms of wider society, where a zero-risk strategy could lead to disproportionate investment in safety measures[72]. Over-investment in potentially unnecessary fire safety measures could lead to an underinvestment in other areas[49]. Societal expectations play a role and may inform the requirements of a regulatory regime, while the fire investigation and learning process following a high-consequence event influence the direction of regulation[15]. When the regulatory direction is established by the Government, it should be supported by clear technical considerations and safety goals to support decision-making regarding buildings to target and the appropriate measures to enforce[73].

The data on which Fire Service audit processes are based should be regularly updated to reflect the current risk within the country[45]. There may also be instances where a measure is considered to be a requirement to mitigate risks at the individual building level. The Economic Impact Analysis for the recent decision on the provision of a second staircase in high-rise residential buildings in England [74] highlighted that applying these measures in all buildings would not be cost-beneficial as the total projected cost to society would be over £1 billion. However, in individual buildings, it may be an essential safety feature, especially where a high number of residents are likely to be unable to escape using stairs. This issue arose from the fire at Grenfell Tower, where 41% of the tower's fatalities involved disabled residents[75].

The standards for performance-based design outline a methodology that can be used for risk-informed decision-making, especially in the design of new buildings[69]. The methodologies for probabilistic risk assessment could also be adopted for existing buildings, both in terms of regulation and risk assessment. However, there is limited information or research for regulators to support decisions about

whether there are sufficient safety measures in existing buildings, particularly those used for residential purposes. There is no set methodology for assessing which buildings should form part of FRS's audit programme[71], leading to variations in which building occupancy types are targeted[44]. The stochastic nature of fire incidents introduces challenges for regulators to target the specific premises where fires may occur in their communities[44]. FRSs may also experience difficulties in deciding upon the most effective measures that are "proportionate" to effectively reduce fire risk. The variations in competence of those working in the design and construction and fire safety fields, as well as those who have oversight of the regulations[2], can lead to an inconsistent understanding and application of the requirements to reduce fire risk to societally accepted levels[49].

7. Conclusions

The research developed in this paper has determined a critical inquiry into the progression of post-WWII fire safety regulation in England from prescription, where safety was detailed by regulators, to a risk-based regime where self-compliance with regulation via a risk assessment process aims to ensure the safety of occupants. The analysis demonstrates that regulations have become less prescriptive over the examined period, with a change to risk-based assessments of safety in both the design and occupation stages of a building's lifecycle. It has also highlighted that risk-based safety is reliant on the clear communication of standards of safety, which, although present for building design, have no equivalent for occupied buildings. This evolution has placed a greater emphasis on the need for building designers, owner/occupiers and regulators to understand building risks and proportionally assess and reduce them to reasonably practicable levels. Guidance is available for fire engineering buildings in PD 7974-7[69]. However, it is reliant upon data that requires a continuous collection of building fire incidents and comprehensive evaluation of fire statistical trends in terms of pre, during and post-fire conditions, as well as life safety and performance of safety measures. Assessment of risk in the post-construction/occupation stage of a building relies on considerations mainly based on whether a suitable and sufficient risk assessment has taken place[7]. The complexity of fire scenarios can pose challenges for regulators. Therefore, there is a need for a critical identification of areas of improvement in building fire safety regulations, especially in the assessment of fire risks, to support the regulatory understanding of a correct application of proportionate safety. The development of a comprehensive model for regulators could enhance decision-making in reducing the fire consequences in various building types. Furthermore, a comprehensive analysis of fire statistics, with a specific assessment of the performance of safety measures, advances risk-informed and data-driven approaches. A correlation between the findings from fire events and enforcement actions could identify real fire scenarios in several property types, key safety features and their failure mechanisms while creating the basis for a research-based evaluation of proportionality and acceptable risk in a risk-based regulatory regime for buildings.

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