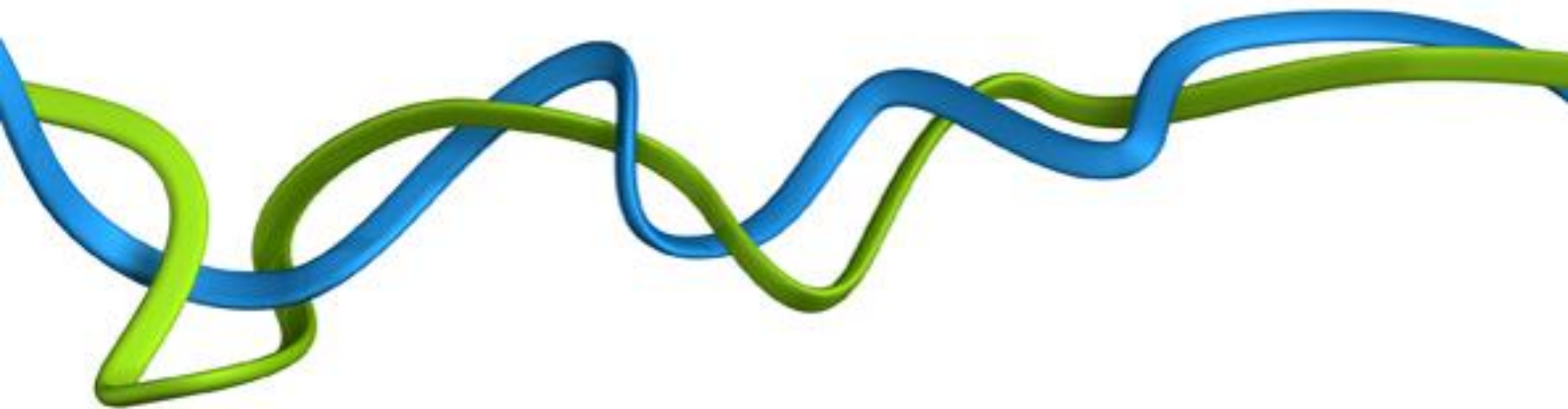


# Independent review on building regulations and fire safety

October 2017



## Key messages

We welcome the opportunity to respond to this call for evidence to the independent review on building regulations and fire safety chaired by Dame Judith Hackitt DBE FREng. This is a cross-engineering sector response led by the Royal Academy of Engineering, produced on behalf of Engineering the Future, an alliance of the 38 professional engineering bodies in the UK.

The key messages can be summarised as follows:

- There is significant confusion in the sector around the interaction of regulations relating to building and housing, including the Building Regulations, the Regulatory Reform (Fire Safety) Order and the Construction (Design and Management) Regulations, in terms of their requirements, but particularly in terms of the allocation of roles and responsibilities. There is a pressing need for a clear and consistent definition of responsibility in relation to fire safety, and other aspects of safety, across regulations.
- There are specific concerns around some areas of Approved Document B that are felt to be unclear or insufficient for fire safety. Some contributors feel that there should be requirements for greater resilience in fire safety of buildings, particularly for high-rise buildings given the possibility of poorly maintained compartmentation. Also several paragraphs, including those addressing external surfaces, are unclear and difficult to interpret and use.
- Some contributors have major concerns about responsibility for building control, and fee bidding between local authority building control and approved inspectors. The move in recent years to greater privatisation of building control generates the potential for significant conflicts of interest, putting independent assessment of regulatory compliance at risk. Many contributors to this response advocate the introduction of a stronger independent building control system, with clear roles, responsibilities, and resources, including clearly defined and consistent competence levels, to assess compliance with regulations.
- The lack of requirement for the demonstration of competence, for example through accreditation, of those responsible for design and construction has been raised as a serious concern:
  - Design – There is no requirement in England for building designs to be completed or approved by accredited professionals, despite the existence of professional bodies and qualification schemes in this field. While some contributors feel that at the design stage professionals have largely been appropriately trained and are adequately resourced to produce competent work, others feel this is a risk in the system and should be reviewed.
  - Construction - A lack of training and requirement for accreditation in the construction sector is problematic, particularly the lack of awareness of regulations, roles and responsibilities. The accreditation system for professionals in the construction industry should be thoroughly evaluated, and improved training throughout the sector would be beneficial.
- It is important that there is a mechanism for feedback of trends, changes, and concerns to enable regulation to be updated and keep pace with changing practice. Effective feedback and review will be dependent on sufficient capability and capacity in independent building control to identify technical trends and feed these back into central government.
- In general, it is considered that the systems for safety checking of building components are robust in ensuring the quality of components to specified standards at the point of sale. However, these components can be installed and maintained in a range of contexts that can impact on the integrity of the component and its function. Therefore,

there may be advantages in requiring greater testing in different contexts particularly for new components, or in improving the capacity of building control to ensure components are installed or maintained as intended.

- There are a number of lessons that can be learned from the regulation of other sectors in the UK, as well as the regulation of buildings in other countries, including the devolved nations. For example, it would be valuable to consider the systems approach taken to the review of health and safety and work regulation in the 1970s, and the changes in the following years, leading to a well-respected regulatory system today.

## **Introduction**

We welcome the opportunity to respond to this call for evidence to the independent review on building regulations and fire safety chaired by Dame Judith Hackitt DBE FREng. This is a cross-engineering sector response, produced on behalf of Engineering the Future, an alliance of the 38 professional engineering bodies in the UK (see Appendix). The response was led by the Royal Academy of Engineering with active input or review from:

British Institute of Non-Destructive Testing  
Chartered Institution of Building Services Engineers  
Chartered Institution of Highways & Transportation  
Energy Institute  
Engineering Council  
Institute of Healthcare Engineering and Estate Management  
Institute of Marine Engineering, Science and Technology  
Institution of Chemical Engineers  
Institution of Civil Engineers  
Institution of Engineering and Technology  
Institution of Engineering Designers  
Institution of Gas Engineers and Managers  
Institute of Measurement and Control  
Institution of Mechanical Engineers  
Institution of Royal Engineers  
Institution of Structural Engineers

This response has been informed by the expertise of the Academy's Fellowship, a roundtable meeting hosted by the Academy in August 2017, and a workshop meeting with representatives of the Professional Engineering Institutions.

## **General points**

1. The importance of taking a systems approach to the review of building regulations and fire safety has been raised by many contributors throughout all elements of this call for evidence. All elements of the system, including legislation, guidance, industry skills and capacity, the enforcement process, and regulatory capacity, interact to create a functional system. Human and corporate behaviours across implementation, maintenance, and regulatory functions must also be considered, and significant culture change may be required in some areas of the system. The responses to the questions below, and proposals or suggestions made, should be viewed in this context, being interdependent from responses to other questions. This interdependence has been highlighted where it is particularly important. One example where a systems approach has been successfully taken to the review of a regulatory system is the Robens report of industrial health and safety from the 1970s<sup>1</sup>. We suggest that it would be valuable for this review to take a similar approach, including clearly defining upfront the boundaries, elements, and interfaces within the system. A systems approach should also be taken to fire safety within the building to ensure maintenance of fire safety across the lifecycle and use patterns of the building.

---

<sup>1</sup> *Safety and health at work. Report of the committee 1970-72* Chairman Lord Robens. July 1972

2. Building and fire safety regulations differ in their requirements and implementation between the devolved nations of the UK. The answers provided below relate to the English system unless otherwise stated. There may be lessons that can be learned from the approaches taken in the devolved nations (see question 9).
3. The responses to the questions below have largely focused on the fire safety of buildings, as this is the primary focus of the review. However, contributors have highlighted that some concerns raised, particularly cultural concerns around procurement practices, value engineering (reducing costs at the expense of other factors), and confusion around responsibilities, are also found in other areas of building projects including environmental assessment such as wind safety.
4. The responses below largely relate to all buildings, but are particularly focused on residential buildings. They do not specifically relate to high-rise buildings unless stated.
5. Contributors to this response work across the building sector, and do not primarily have deep expertise in fire engineering. Those with significant expertise in the fire engineering field may find the requirements of the regulations clearer than those that do not; however, it is important that the overarching requirements of the regulations and their interactions with other elements of the system are clear to those working across the building sector.

## **The overarching legal requirements**

**Q1 To what extent are the current building, housing and fire safety legislation and associated guidance clear and understood by those who need to follow them? In particular:**

- **What parts are clear and well understood by those who need to follow them?; and, if appropriate**
- **Where specifically do you think there are gaps, inconsistencies and/or overlaps (including between different parts of the legislation and guidance)? What changes would be necessary to address these and what are the benefits of doing so?**

### **General**

6. The large majority of contributors to this response feel that the legislation and guidance are complex and hard for many in the sector to navigate. Although, it should be noted that some contributors consider these documents to be clear and well-defined.
7. At the highest level of regulatory organisation, there is confusion and uncertainty around the interaction of regulations relevant to building and housing, including the Building Act, the Building Regulations that are made under the Act, the Regulatory Reform (Fire Safety) Order, and the Construction (Design and Management) Regulations, which plays an important role in defining roles and responsibilities in relation to building works. There is confusion in terms of their requirements, but particularly in terms of the allocation of roles and responsibilities. It is noted that some provisions in these regulations refer to different phases in the life of a building. Their interaction with other regulations such as the Housing Act and legislation governing safety in workplaces, that applies during construction, can also add to difficulties.
8. The parallel application of these regulations at different stages of the building lifecycle (from design through to maintenance and refurbishment) is not always clear. Lessons could be learned from the health and safety at work sector, where there is a cascade of legislation from the primary Health and Safety at Work Act 1974 (see question 10,

paragraph 74), although it should be noted that the context and audience of this legislation is different to the building regulations.

9. Additionally, the approach taken by these regulations is different, with the Regulatory Reform (Fire Safety) Order, and the Construction (Design and Management) Regulations having a stronger emphasis on risk assessment than the Building Regulations. More consistency in approach between regulations may improve their alignment and make them easier to use.
10. Specific concerns on gaps and inconsistencies in the regulations are described below.

### **Performance-based versus prescriptive requirements**

11. It is broadly agreed that the approach taken in the current building regulations, to have both performance-based statements with more prescriptive guidance, is appropriate. This approach both provides straightforward routes for compliance for simple projects while allowing for innovation in the sector. Additionally, the complexity of building systems means that a completely prescriptive approach covering all possible approaches to design and construction is unlikely to be feasible. It is important that within the regulations and associated guidance desired performance outcomes are clearly defined, and that prescriptive requirements are clear and easy to follow (see paragraph 14).
12. However, there are concerns that the movement towards increasing use of a performance-based approach in regulations, guidance, and standards, for complex systems such as buildings may be problematic. This is because errors can occur through a lack of adequate training and knowledge if reliance is placed wholly on achieving performance outcomes, and unintended consequences may not be identified. A performance-based approach for components and products can be highly beneficial. This approach allows for innovation in design, and performance outcomes are usually easily measurable ahead of use, providing indicators that give confidence in the performance of the product. In contrast, for complex systems such as buildings, it is very difficult to test the performance of the whole system up front, and therefore to provide confidence that performance-based standards or goals have been met by the design and installation. This places even more onus on appropriate competence across the parties involved in the design and construction process. Therefore, performance-based criteria should be used carefully in regulations, guidance, and standards, and it may be valuable to use more prescriptive approaches where the performance of the system is highly complex or cannot be readily tested or validated<sup>2</sup>.
13. One suggestion is that the Building Regulations could take a more risk-based approach to applying performance-based and prescriptive requirements. Prescriptive requirements could be applied to low-risk buildings but more complex high-risk projects could be required to demonstrate that risk had been considered and designed by competent and qualified people to be as low as reasonably practicable. This would require thorough risk assessment based on factors such as function, size, and occupancy level of the building (see question 8, paragraph 67). Such a risk-based approach would align more closely with the approach taken in the Regulatory Reform (Fire Safety) Order, and the Construction (Design and Management) Regulations, and with the approach taken in other sectors, such as Health and Safety at Work (see question 10, paragraph 74).

---

<sup>2</sup> *Performance-based requirements: Meaning, limitations and ways forward*. Denton S, & Angelino M (2017). White paper for the Structural Engineering Institute 'Performance Based Codes and Standards' Committee.

14. It is important that within the regulations and associated guidance, the desired performance outcomes are clearly defined and that prescriptive requirements are clear and easy to follow. Particularly, a lack of clear guidance with respect to fire safety can make it difficult for design teams to defend to clients more expensive but more resilient approaches, such as the inclusion of additional lobby area, sprinklers, or greater number of escape routes. The implications of procurement practices in the building industry are discussed further below, and will be assessed as part of ongoing reviews by both the Construction Industry Council and the Institution of Civil Engineers<sup>3</sup>, which are likely to result in recommendations for good practice in the sector. This is one area where a systems approach is important to consider the interface between the regulatory approach and practices in the sector.
15. There are several specific places where it is felt that the current building regulations and associated guidance, particularly in relation to fire safety, are unclear. These are outlined below.

### **Lack of clarity in purpose statements**

16. The overarching purposes of the Building Regulations are sometimes unclear or inconsistently described. For example, regulation 8 of the Building Regulations 2010 states that '*Parts A to D, F to K, N and P (except for paragraphs G2, H2 and J7) of Schedule 1 shall not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about buildings*'. However, the Explanatory Memorandum issued alongside the Building Regulations 2010 describes a much broader role for the Building Regulations. These purposes are also referred to in an inconsistent manner in the introductions to the Approved Documents. This does not generally cause confusion for the design of conventional buildings, but it could do for more complex construction and so it would be useful to ensure consistency of purpose in the regulations, particularly for unconventional projects.
17. The purpose statements of each section in Approved Document B can also be limited. The introduction to Approved Document B4 states that the purpose of the section's requirements is to 'limit the risk of a fire spreading from the building to a building beyond the boundary, or vice versa'. However, the purpose of the section is broader than this, including seeking to limit fire spread between compartments of buildings (section B4 12.2). Greater clarity and complete definition of purpose is particularly important for unconventional projects, where it may be necessary to use an approach not provided in the prescriptive or deemed to satisfy requirements.

### **Concerns on prescriptive requirements, particularly in Approved Document B**

18. Approved Document B on fire safety is considered difficult to use; a 2015 survey of Construction Industry Council members by the Fire Sector Federation found that over half of respondents found the document difficult to use.<sup>4</sup> Specific areas of Approved Document B that have been highlighted as being ambiguous or difficult to interpret include paragraphs 12.5, 12.7 and 12.8, Diagram 40, and the requirements for 'unprotected areas' described in paragraph 13.7 onwards. There are also slight differences in wording between the guidance and British standards addressing the same topic; one example is between paragraph 12.7 in Approved Document B and in BS9991. Such differences occur primarily due to British standards being reviewed and updated more frequently than the statutory guidance, and have the potential to generate some

---

<sup>3</sup> ICE review to examine wider lessons from Grenfell Tower tragedy, 2017, <https://www.ice.org.uk/news-and-insight/latest-ice-news/ice-president-to-chair-review-of-civil-engineering>

<sup>4</sup> *Why does Approved Document B need to be reviewed?* Fire Safety Federation, June 2017

confusion in the sector. More regular reviews of the statutory guidance (see paragraphs 27-29) or explanations provided for the differences, may be helpful here.

19. There is concern that the current building regulations lack requirements for resilience in fire safety strategies that is important for when elements of the system fail. Many high-rise buildings in the UK depend heavily on compartmentation principles, with a lack of resilience in case of poorly executed compartmentation or compartmentation failure. There is concern that this lack of resilience means that fire safety is not sufficiently maintained across the lifetime of the building, through operation, refurbishment and modification, when compartmentation is rarely rigorously reviewed and can fail due to neglect or modification. The protection of a single escape route from both smoke and fire is an essential part of the presumption of escape in high-rise buildings<sup>5</sup>. Strengthening the regulations to make them state more explicitly that it is essential to maintain this escape during refurbishment and maintenance should be a high priority. Building regulations should give clearer guidance on when a major refurbishment requires the application of all the current building regulations standards (see paragraphs 25-26).

Fire safety systems inevitably degrade over the life of a building through neglect, ignorance of their importance, poor maintenance, or vandalism. It is important that regulations and guidance consider this, including human factors such as the culture and competence of maintenance staff (see question 4, paragraph 50), and ensure sufficient resilience in the system over the lifetime of the building to maintain safety.

There may be lessons to learn from regulations in other countries that require greater resilience or redundancy for high-risk buildings, such as active fire protection mechanisms like sprinklers, and adaptable escape strategies including voice controlled alarm systems, in addition to passive protection mechanisms and those currently required by Approved Document B. There may also be lessons to learn from the regulation of other high-risk sectors where resilience in safety systems is key (see question 10, paragraphs 79-81).

Improving competence and capability of those involved in the sector, including construction and maintenance, is important to reduce the chance of poorly executed or maintained compartmentation (see question 4), and improve the robustness of this important protective approach in practice.

20. While we do not wish to comment on the causes or contributory factors in the Grenfell Tower fire, there is concern following the Grenfell Tower fire and other fires affecting high-rise buildings around the world about the use of flammable materials on the exterior of high-rise buildings. Some contributors recommend that, with the updated knowledge available, the large-scale use (that is for entire façades) of such materials on high-rise buildings should be more explicitly prohibited in the approved documents, as part of the broader review of the regulatory system. The use of fire-retardant materials should also be evaluated carefully prior to the recommendation of their use, given the increased potential for the release of toxic gases from such materials in the case of fire.
21. The route provided in the approved documents for using 'desktop studies' to demonstrate compliance with the regulations should be more clearly and tightly defined. This route may be valuable and effective in certain cases where extrapolation from closely related test data is appropriate, and when conducted and reviewed by

---

<sup>5</sup> *Fire safety in purpose-built blocks of flats*. Local Government Association 2012; paragraph 16.9



competent individuals (see question 4, paragraph 52). However, it is not suited to widespread use or distant extrapolation, and the context for its use should be more tightly defined within the guidance documents to prevent inappropriately broad interpretation.

22. There are some places where there is potential for confusion between the requirements of the building regulation guidance and requirements of other interacting legislation. For example, the building regulations imply fire stopping should be carried out at the end of fitting out the building, whereas the Pipeline Safety Regulations and Gas Safety (Installation and Use) Regulations require sleeves to be sealed (that is, fire stopped) before the pipework is commissioned. Similarly, there appear to be inconsistencies between the building regulations, fire safety regulations, and industry guidance in relation to boxing in and ventilation of gas pipes.

### **Language**

23. There is confusion around the use of some terms across building legislation, guidance, standards, and everyday or common usage, particularly related to fire safety. The terms 'limited combustibility' and 'non-combustible' are one example, with each having multiple and confusing definitions within the regulatory guidance<sup>6</sup>, and different meanings again in common usage. Other examples that can be ambiguous include 'insulation', 'fire resistant', and 'fire retardant'. The definition of a common, consistent and intuitive technical language for fire and safety related areas that can be easily understood by relevant professionals from different disciplines is critically important.
24. There is also confusion around the term 'person carrying out building work' in the Building Regulations, leading to a lack of clarity on responsibility (see question 2 and 3).

### **Maintenance and refurbishment**

25. As mentioned above, there can be confusion in relation to maintenance and refurbishment of buildings when legislation and guidance has changed since construction of the building. There is often a need to interface existing construction with new elements such as external cladding, windows, services (such as pipes or cables), and so on. Greater guidance on responsibilities for risk assessment and decision making with respect to regulatory compliance in relation to refurbishment and modification of existing buildings would be valuable. Furthermore, clarification of the interaction of requirements and responsibilities for fire safety with other areas such as gas or electrical supply in relation to refurbishment and maintenance would be helpful.
26. In the electrical sector, there can be difficulties in defining legal ownership of supply installations including risers, laterals and distribution panels due to historical changes in ownership of the building and transfers of responsibilities from distributed network operators after privatisation. This leads to neglect of installations in buildings and no incentive to take responsibility for ageing equipment over the lifetime of a building or during refurbishment and maintenance. The Institution of Engineering and Technology publishes a Code of Practice for Electrical Safety Management and runs an associated training course, which is a valuable source of guidance for the sector.

### **Feedback and review**

27. The building sector is relatively innovative, which can create challenges for the regulatory system, building control, and industry self-regulation to keep pace with

---

<sup>6</sup> *Approved Document B Fire Safety: Volume 2 2006 edition*, pg 130-131

industry practice. It is important that there is a mechanism for feedback of trends, changes, and concerns from the sector and those working in building control to enable regulation or guidance to be updated to keep pace with changing practice, and for building control bodies to maintain appropriate competence through continuous training and development. Such feedback should consider the whole system including operational and maintenance factors, human factors that may precipitate or exacerbate incidents, failure frequency and rate data, and observed trends in the sector.

28. Some countries have scheduled review cycles for their building regulations and guidance, which should facilitate regulations keeping pace with changing technology and practice within the sector (see question 9). It may be valuable for England to consider scheduling such regular reviews for the regulations and associated statutory guidance, as proposed for example in the 2009 Communities and Local Government document, *Future of Building Control*<sup>7</sup>.
29. However, effective feedback and review relies heavily on there being sufficient capability and capacity in independent building control to identify technical trends and feed these back into central government. This highlights the importance of taking a systems approach to any review, and the capacity of building control as a key and relevant issue (see paragraphs 40-43 and 53-54).

### **Record keeping**

30. Feedback and review of guidance also depends upon appropriate record keeping on the design, fire safety strategy, construction, and maintenance of buildings. At present there is little requirement for industry, building control, or building owners to maintain such records or for such records to be maintained centrally. Mandating a repository of such information, either locally or centrally, may facilitate regulatory review, information transfer at points of transition in building projects, and rapid review of responsibilities for individual projects. This would supplement Regulations 38 and 40 of the Building Regulations, and requirements in the Construction (Design and Maintenance) Regulations, that are not always met in practice and can be difficult to enforce. Further use of Building Information Modelling (BIM)<sup>8</sup> may also be helpful here. Blockchain technology may also assist in the immutability of documents and their sign-offs.
31. The Construction (Design and Management) Regulations require as-built information, including drawings, to be given to owners but again this is rarely done. The Institution of Civil Engineers, Institution of Structural Engineers, and the Health and Safety Executive together with the Land Registry are currently looking at ways to encourage the deposition of drawings in a central register. This work has been initiated by Structural-Safety<sup>9</sup>.

### **Roles & Responsibilities**

**Q2 Are the roles, responsibilities & accountabilities of different individuals (in relation to adhering to fire safety requirements or assessing compliance) at each key stage of the building process clear, effective and timely? In particular:**

- **Where are responsibilities clear, effective and timely and well understood by those who need to adhere to them/assess them?; and, if appropriate**

---

<sup>7</sup> *Future of Building Control: Implementation Plan*. Department for Communities and Local Government 2009

<sup>8</sup> *Building Information Modelling*, HMGovernment, 2012, <https://www.gov.uk/government/publications/building-information-modelling>

<sup>9</sup> Structural-Safety <http://www.structural-safety.org/about-us/> Accessed 11/10/17

- **Where specifically do you think the regime is not effective?**
- **What changes would be necessary to address these and what are the benefits of doing so?**

**And**

**Q3 Does the current system place a clear over-arching responsibility on named parties for maintaining/ ensuring fire safety requirements are met in a high-rise multi occupancy building? Where could this be made clearer? What would be the benefits of doing so?**

### **Responsibility for compliance**

32. Overall, there is significant confusion around roles and responsibilities of different professionals in the building and fire safety process. The Construction (Design and Management) Regulations are viewed as a positive contribution to defining roles and responsibilities. However, their interaction with other regulations, such as the Building Regulations and Regulatory Reform (Fire Safety) Order, is unclear and they do not cover maintenance or use of buildings beyond design, construction, or major refurbishment. There is a pressing need for clear and consistent definition of responsibility for the fire safety of buildings across regulations. It is also important that the responsible person or people have the necessary competence to fulfil this role (see question 4).
33. The greatest lack of clarity is perceived to be where there are discontinuities in the building process, for example between building design and construction; completion and operation; or operation and refurbishment. These discontinuities can raise challenges due to lack of information exchange on fire safety, despite requirements for transfer of fire safety information outlined in Regulation 38 of the Building Regulations, as well as a lack of clarity on responsibilities. Increased use of Building Information modelling (BIM)<sup>10</sup> may facilitate clear and timely transfer of information during these transitions. However, increasing use of BIM is likely to take some time, and improvements in communication via traditional methods will be important in the interim period.

Confusion on definitions in the regulations:

34. In general, the building regulations allocate responsibility for compliance to the 'person carrying out the work'. This term is not clearly defined within the regulations, including whether it refers to individuals or corporations, or to owners, builders, or contractors. Responsibilities are not clearly allocated between professionals and, combined with the absence of requirement for accreditation or certification of these individuals (see question 4), this leads to a lack of clarity on responsibilities and accountabilities.
35. Regulation 38 of the Building Regulations, which covers fire safety information, refers to a 'responsible person'. This is only defined by reference to the Regulatory Reform (Fire Safety) Order 2005, adding further complexity to navigating responsibilities within the multiple interacting regulations.

Confusion on responsibilities in practice:

---

<sup>10</sup> *Building Information Modelling*, HMGovernment, 2012, <https://www.gov.uk/government/publications/building-information-modelling>

36. At the design stage, responsibility for fire safety compliance in design is widely perceived to sit with the architect who consults with other professionals when relevant, such as building services engineers, fire consultants, and structural engineers. At this stage, contributors largely perceive the process as clear and effective, with good levels of competence in the sector. However, there is little requirement or regulation of competence at the design stage (see question 4, paragraph 48) which many contributors view as problematic and a major risk in the sector.
37. As the project moves to construction the main contractor usually has responsibility for ensuring the work is conducted to the original design. Complex supply chains can mean that the main contractor may not have detailed knowledge of individual elements of the project, making responsibility and accountability for fire safety more complex. For example, risks may arise in the case of product substitutions where the alternative product may not be checked for compliance in the context of the whole system. An increase in 'design and build' contracts, where the main contractor is appointed to design and construct the building, has particularly led to complex contractual arrangements that can create a lack of clarity over responsibility and accountability. 'Value engineering' measures should be required to be documented, and to demonstrate no compromise to fire safety. Procurement practices will be examined in ongoing reviews by both the Construction Industry Council and Institution of Civil Engineers<sup>11</sup>, which are likely to result in recommendations for good practice in the sector.
38. Construction involves much work that is not readily visible (that is, it is covered up), making competent inspection essential. It is currently unclear who has final responsibility for ensuring compliance against original designs and regulatory requirements. In practice, design teams are rarely expected or invited to visit sites to review completion against original designs, and main contractors can have a lack of detailed understanding of the processes conducted on site. It is important that there is a clearly defined responsible role to sign off work that is separate and independent from a building control or enforcement role. It has been suggested that one route that would be valuable in improving compliance in final construction, may be the re-introduction of a clerk of works role across all building projects. This would need to be considered in relation to the wider regulatory system, including their relationship with building owners, contractors, and local authorities.
39. Responsibility for interacting elements of the building services, such as gas supply, can also be unclear over the lifetime of the building. For example, clear guidance on responsibility for gas distribution pipework and associated items, such as valves, boxing, and ventilation, at each stage of a building's life cycle would be valuable.

### **Responsibility for building control**

40. There is a major concern among contributors to this response about current responsibility for building control. The move in recent years to greater privatisation of building control and extensive use of private approved inspectors, appointed by clients rather than by local authority building control, generates significant conflicts of interest in the system. Private approved inspectors are contracted by building owners or contractors from whom they will often seek repeat business in competition with others, including local authority building control. This arrangement is not conducive to independent rigorous building control or assessment of regulatory compliance. This was highlighted in last year's All Party Parliamentary Group for Excellence in the Built

---

<sup>11</sup> ICE review to examine wider lessons from Grenfell Tower tragedy, 2017, <https://www.ice.org.uk/news-and-insight/latest-ice-news/ice-president-to-chair-review-of-civil-engineering>

Environment report on housing quality as a contributory factor for the decrease in housing construction quality over recent years<sup>12</sup>, and it was recommended that the standards for compliance inspections be reviewed.

41. The increase in privatisation of building control has also led to a decrease in capacity and technical expertise within local authorities, who are also not subject to formal qualification and training requirements unlike approved inspectors (see paragraph 53). This decrease in capacity has knock-on effects on the system. Firstly, approved inspectors have limited authority for regulatory enforcement, relying on referral to local authorities when needed. The decrease in capacity in local authorities means there can be a lack of capacity within building control to interpret and act on these referrals, which is problematic. Local authorities cannot recover costs for such enforcement actions which may be a further barrier to effective control. Secondly, as outlined above, the capacity for local authorities to identify and to feed back trends and changes in practice in the sector is also diminished, meaning regulations do not keep pace with changes in industry.
42. There has also been decline in the presence of resident engineers and clerks of works on site. This is often due to clients being persuaded that the services of such inspectors are costly and unnecessary, without sufficient understanding of the role of these services in reducing risk. The importance of independent site visits was highlighted in the recent independent inquiry into the construction of Edinburgh schools, which stated that 'the awareness by site operatives of the presence of clerks of works on site can impact positively on their approach to the quality of their work'<sup>13</sup> (see paragraph 38 above).
43. Many contributors to this response therefore advocate the introduction of a stronger independent building control system, with clear roles, responsibilities, competence requirements and resources to assess compliance with regulations.
44. One possible suggestion provided is that the fire and rescue authorities, through their engineering divisions, could take responsibility for enforcement of fire safety in relation to building projects, in addition to enforcing compliance with the Regulatory Reform (Fire Safety) Order. This would require a significant increase in their capacity.

### **Responsibility for changes in practice**

45. As outlined above, the building sector is innovative, which can result in rapid changes in technologies and practices. This raises challenges for the regulatory system, building control, and industry self-regulation to keep pace with changes in the industry. There is no clear responsibility for review and oversight of advances in the sector and changes in accepted practice. Regularly scheduled governmental reviews of the building regulations and guidance, focusing on changes in practice in the sector, could help address this deficiency. However, as outlined above, this will depend on increased capacity in the regulatory and enforcement sector to identify and feed back trends.

### **Other responsibilities**

46. This response focuses primarily on fire safety regulations in terms of life safety. However, property preservation should also be considered in relation to fire, and the

---

<sup>12</sup> *More homes, fewer complaints. Report from the commission of inquiry into the quality and workmanship of new housing in England.* All Part Parliamentary Group for Excellence in the Built Environment. July 2016

<sup>13</sup> Report of the Independent Inquiry into the Construction of Edinburgh Schools, 2017, pg 12.

responsibility and early involvement of the insurance sector in building design and material selection could be valuable here.

## Competencies of key players

### Q4 What evidence is there that those with responsibility for:

- **Demonstrating compliance (with building regulations, housing & fire safety requirements) at various stages in the life cycle of a building;**
- **Assessing compliance with those requirements**

**are appropriately trained and accredited and are adequately resourced to perform their role effectively (including whether there are enough qualified professionals in each key area)? If gaps exist how can they be addressed and what would be the benefits of doing so?**

### Those responsible for compliance

47. The lack of requirement for certification and accreditation of those responsible for design and construction has been raised as a serious concern by contributors. This is in contrast to related sectors, such as gas engineers, where registration is mandatory through the Gas Safe Register, with requirements for appropriate qualification and training prior to registration. This scheme is viewed positively by the industry.
48. **Design** – Many countries require that all building designs and plans submitted for approval be prepared and approved by qualified engineers or architects. In England there is no such provision, despite administration of relevant professional qualifications by several professional bodies. Some contributors feel that up to the design stage of building projects, professionals such as architects, structural engineers, and fire consultants, have largely been appropriately trained, have competence recognised through the chartership system, and are adequately resourced to work together in a competent manner. However, others feel that the lack of prescriptive requirements for qualifications in this area presents serious risks in the system and this should be reviewed.
49. **Construction** – Similarly, for physical construction work there is no prescriptive requirement for training, accreditation, or continuing professional development of construction operatives. A lack of training and skills development in the construction sector in the UK has been noted as a major concern, both for safety and productivity, by several recent reports including the Farmer review of the UK construction labour model<sup>14</sup>. Specifically, relevant to fire safety, surveys by the Fire Safety Federation have highlighted a lack of understanding of the building and fire safety regulations and guidance in the building and construction industry<sup>15</sup>. There is concern that, whilst senior engineers and professionals may have a good understanding of requirements and be appropriately qualified, knowledge may not be present at more junior levels, throughout the supply chain or at a site level. This may lead to decisions being taken in the construction process that compromise the resilience of initial designs. The accreditation process for professionals in the construction industry should be thoroughly evaluated. Improved education throughout the supply chain and construction industry, perhaps particularly in relation to the importance of regulatory requirements, roles and responsibilities, would be beneficial.

---

<sup>14</sup> *Modernise or die. The Farmer review of the UK construction labour model.* Construction Leadership Council. October 2016

<sup>15</sup> *Why does Approved Document B need to be reviewed?* Fire Safety Federation, June 2017

50. **Maintenance** – Relatedly, many engineered fire systems rely heavily on mechanical and electrical systems that require appropriate maintenance and testing over their lifetime. This requires appropriate training of building maintenance staff, which is frequently overlooked.
51. **Fire safety engineering** – Some contributors also recommend a stronger or more rigorous accreditation process for professionals consulting on fire safety engineering or fire risk under the auspices of a relevant professional association. The mandatory registration of gas engineers could be a model for this sector. Any change in certification processes should be viewed in the context of the wider framework, including how the regulations define the role and responsibility for certified professionals.
52. **Desk top studies** – As outlined above, one route for demonstrating compliance with the regulations is through a 'desk top study'. It is important that those conducting and reviewing such studies are competent to do so, including understanding the limitations of the approach, and requiring greater demonstration of competence for this role may also be valuable.

### **Those responsible for assessing compliance**

53. As outlined above, increased privatisation of the building control process has led to a reduction in building control capability and capacity, particularly in local authorities, which has been raised as a significant concern. Some contributors have advocated increasing local authority responsibility for building control, which would require increased training and capacity. It is important that building control bodies have the right competence and capability to assess compliance, including the fire safety, of complex buildings, and that this competency is clearly defined. These requirements for competency and training should be consistent across building control; currently, local authorities are not subject to formal qualification and training requirements, unlike approved inspectors under the Construction Industry Council Approved Inspector Register.
54. In Scotland, the Certification of Structural Design in Scotland scheme, run by SER Ltd, is responsible for the review of around 85% of building applications. Once an application has been reviewed by the scheme, the local authority is obliged to approve the application. The scheme allows only chartered engineers, who are accredited and routinely audited, to certify the applications as being in compliance with the building regulations. Independent research has shown that the reviews by the scheme's approved certifiers are more comprehensive than those performed outside of the scheme<sup>16</sup>. This has the potential to be used as a model for a similar system of certification and compliance review in England.

### **Enforcement & Sanctions**

#### **Q5 Is the current checking and inspection regime adequately backed up through enforcement and sanctions? In particular**

- **Where does the regime already adequately drive compliance or ensure remedial action is always taken in a timely manner where needed?**
- **Where does the system fail to do so? Are changes required to address this and what would be the benefits of doing so?**

---

<sup>16</sup> *A study into the level of checking of structural design*. BRE for The Scottish Government. 2014

## **Improving compliance**

55. External independent building control and associated inspections of work are important. This was highlighted in the recent independent inquiry into the construction of Edinburgh schools, which stated that 'the awareness by site operatives of the presence of clerks of works on site can impact positively on their approach to the quality of their work'<sup>17</sup>. It has been suggested that the re-introduction of a clerk of works or similar role would be valuable in improving compliance in final construction. This would need to be considered in relation to the wider regulatory system, including their relationship with building owners, contractors, building control, and local authorities.

## **Regulatory enforcement**

56. As outlined above, there is significant concern in the sector about the decline in building control expertise and capacity in recent years, particularly in local authorities, and the significant conflict of interest in the system that is generated through the privatisation of building control. As described above, the privatisation of building control and decrease in local authority capacity is perceived to have led to gaps in control, oversight, quality assurance, and the ability for authorities to effectively challenge and regulate the sector.

57. One issue with the enforcement of the regulations is the possibility of work (mostly small-scale work) being conducted outside of the regulatory system; that is, if no applications are made then no inspections or review are conducted. It is difficult to assess the extent of, and address, this problem.

58. There can be challenges related to the fact that the authority responsible for enforcement of the Regulatory Reform (Fire Safety) Order is different from that responsible for building control, meaning there may not be a joined-up approach between the two enforcing authorities.

59. One area where this can be a challenge is in relation to building notices. England and Wales have two routes to notify building control authorities of building projects: issue of a building notice, and the full submission of plans for approval in advance of work starting. The first of these routes has been raised as a risk or concern by some contributors to this response. A building notice requires only 24 hours' notice of work beginning and no technical description of the work. This route is intended only for use in small domestic projects that do not need to comply with the Regulatory Reform (Fire Safety) Order 2005. Some contributors have concerns around this route for the following three reasons. Firstly, as mentioned, the authority responsible for the Regulatory Reform (Fire Safety) Order is different from that responsible for building control, so it is not always clear or obvious whether the order applies and so when the route is valid. Secondly, requiring review and approval of plans may reduce work conducted without approval (it is considered that compliance with the system of obtaining approval in Scotland is higher than England). Finally, it makes subsequent review of compliance and final approval much easier for building control officials, as works can be checked against plans and designs rather than the list of building regulations. However, others contributors feel that the use of building notices is not problematic as long as they are used within their intended remit for simple projects.

## **Improving practice**

60. Independent rigorous building control, with appropriate authority to enforce regulations and impose sanctions when needed, is important for effective regulation of the system.

---

<sup>17</sup> Report of the Independent Inquiry into the Construction of Edinburgh Schools, 2017, pg 12.



However, the ultimate aim of building control and regulation is to improve quality and compliance in the sector. There is therefore a need to cultivate good communication and positive relationships across the design, construction, building control, and local authorities, to facilitate the improvement of quality and workmanship. Some local authorities with sufficient capacity advise builders as to the appropriate ways of complying with regulations and only use enforcement as a last resort. This proactive approach is said to yield benefits in terms of improving practice and enhancing compliance of future projects.

61. Related to this, it would be highly beneficial to promote a culture of greater openness and transparency across the building sector that encourages reporting of errors, trends, and concerns about sector practices, as exists in sectors such as oil and gas, nuclear, and the aviation industry. Routes are needed for the exchange of such information across the sector, including between industry and building control, and mechanisms to ensure such information is fed back into the review of regulations, guidance, and standards. The Confidential Reporting on Structural Safety (CROSS) mechanism<sup>18</sup>, sponsored by the Institution of Structural Engineers, the Institution of Civil Engineers, and the Health and Safety Executive, was established to improve structural safety and reduce failures by using confidential reports to highlight lessons that have been learnt, to generate feedback and to influence change. This could be built on, or used as a model for broader information exchange in the sector. The Hearts & Minds toolkit from the Energy Institute<sup>19</sup>, which is used in the oil and gas sector for improving safety culture, is an example of resources from another sector that could be a useful model for the building sector (see question 10 for more information on lessons from other sectors).

### **Tenants' & Residents' Voice in the current system**

**Q6 Is there an effective means for tenants and other residents to raise concerns about the fire safety of their buildings and to receive feedback? Where might changes be required to ensure tenants'/residents' voices on fire safety can be heard in the future?**

62. The Academy and engineering sector do not have the most appropriate expertise to answer this question.

### **Quality Assurance and Testing of Materials**

**Q7 Does the way building components are safety checked, certified and marketed in relation to building regulations requirements need to change? In particular:**

- **Where is the system sufficiently robust and reliable in maximising fire safety and, if appropriate**
- **Where specifically do you think there are weaknesses/gaps? What changes would be necessary to address these and what would be the benefits of doing so?**

63. In general, it is considered that the systems for safety checking, certifying and marketing building components, including the Construction Products Regulations, are robust in ensuring the quality of components meet certain specified standards at the point of sale. However, these components can be installed in a range of contexts and conditions and maintained in different ways that can impact on the integrity of the

---

<sup>18</sup> Confidential reporting on structural safety, <http://www.structural-safety.org/> Accessed 05/10/17

<sup>19</sup> Hearts & Minds, The Energy Institute, <http://heartsandminds.energyinst.org/> Accessed 10/10/17

component and fall outside the scope of standards, checking and certification. Therefore, there may be advantages in requiring greater testing in different contexts prior to or alongside marketing, particularly for new components, or in improving the capacity of building control to ensure components are installed and maintained as intended. Such testing should be conducted by independent facilities to ensure conflicts of interest with industry are minimised. It is important that the design of any new, modified or more stringent tests does not breach the existing requirements of the Construction Products Regulations and be barriers to trade.

64. On occasion, there is the potential for certificates to be misleading or fraudulent and consideration should be given to a means of identifying products by physical means or electronic tagging to ensure that buyers are receiving what they expect.
65. A significant concern is the potential for product substitution during building works whereby a product specified at design stage may be compliant but be substituted at a later stage for a product which is not compliant or inappropriate in the whole system, and which might not be checked for compliance. This relates directly to responsibility, competence, and building control enforcement (see questions 2, 4, and 5).

### **Differentiation within the current Regulatory System**

#### **Q8 What would be the advantages/disadvantages of creating a greater degree of differentiation in the regulatory system between high-rise multi occupancy residential buildings and other less complex types of residential/non-residential buildings?**

#### **Where specifically do you think further differentiation might assist in ensuring adequate fire safety and what would be the benefits of such changes?**

66. A number of countries that responded to our international call for evidence (see question 9) have regulations that differentiate between residential buildings on the basis of height and size, with different safety requirements, and sometimes review and enforcement processes, for high-rise buildings compared to simple residential buildings.
67. A greater degree of differentiation in the regulatory system could have the advantage of making differentiated safety requirements more visible, and hence clearer, to those with responsibilities under the regulations. It could also facilitate the mandating of stricter review or enforcement processes in relation to high-risk buildings, which may be valuable. Some contributors feel that there are arguments for differentiation based on the number of storeys, such as under three storeys, as is the current definition of low-rise buildings, or under ten storeys, where fire rescue services have more straightforward access to buildings both to remove residents and fight fire. However, there are many risk factors that can affect fire safety in addition to height, including area, function, access, building complexity, and so on. Therefore, it may be more appropriate to differentiate buildings based on a thorough risk assessment of design, rather than on the number of storeys alone. Such risk assessment would require competent professionals and so would need to be considered in the context of the whole system.
68. Additionally, there are certain risks that apply to all high-rise buildings of all occupancy types, not only from fire but also other events such as impacts or natural disasters. The key inter-related challenges are described in the report, *Safety in tall buildings and other buildings with high occupancy*, produced by a working group convened by the Institution of Structural Engineers following the attack on the World Trade Center

buildings<sup>20</sup>. Therefore, it may not be appropriate to differentiate completely between high-rise residential buildings and those of other occupancy types.

69. Part A3 of the building regulations on resistance to progressive collapse categorises buildings by height, occupancy, and function, so a precedent exists within the current system and is one approach that could be extended to differentiation for fire safety.

## **International Comparisons and Other Sectors**

### **Q9 What examples exist from outside England of good practice in regulatory systems that aim to ensure fire safety in similar buildings? What aspects should be specifically considered and why?**

70. The Royal Academy of Engineering circulated a call for evidence on international building regulatory systems to the international networks of academies of engineering, and to individual Fellows with relevant international professional networks, to collect evidence on the building regulatory system in countries outside of the UK. Responses were received from individuals working in the building or building control sector in: Australia, UAE, Canada, Malaysia, the Netherlands and the Czech Republic. The details of these responses have been provided separately to the DCLG review team for their information.
71. Themes arising across this small selection of international responses, that may have lessons for the English regulatory system, can be summarised as follows:
- Some countries have a combined single regulation covering all aspects of building systems (environmental, construction, fire safety etc.), which is generally viewed positively. However, other countries, such as UAE, have distinct regulations that can also result in a functional regulatory system.
  - All responding countries have both prescriptive and performance based routes for compliance, although some may have a stronger reliance on prescriptive methods.
  - Most countries categorise buildings based on function, height, size, and sometimes other factors such as construction method. Different categories of building usually have different requirements for fire safety, and in some countries, different review or enforcement processes.
  - Several countries have regular review cycles for their building regulations, annually, three- or five-yearly.
  - Enforcement processes in most countries include review of design and issue of a permit ahead of construction, and final review and approval on construction completion.
  - Enforcement processes in most countries are currently conducted by local authorities. Some countries are shifting to greater privatisation of building control. This was perceived by some as problematic, reducing independence of the review process and decreasing capacity in local authorities.

---

<sup>20</sup> *Safety in tall buildings and other buildings with large occupancy*. Prepared by an international working group convened by The Institution of Structural Engineers. July 2002.

- In general, the content of regulations and codes was viewed as appropriate across countries. Where mistakes or incidents have occurred it has generally been due to problems with administration, confusion, or malpractice, rather than with the content of the regulations themselves.
- Confusion is generally created for the building industry where the interfaces between different regulations, different authorities or jurisdictions, or the application of regulations to existing or new buildings is unclear.

72. In addition, there have been fires in high-rise buildings in several other countries over recent years. As well as exploring the broad characteristics of the regulatory system in other countries, it may be valuable to explore how they have responded and updated regulations following such incidents, as there may be lessons to be learned for the UK system and review process. The Council on Tall Buildings and Urban Habitat is seeking to collate such information from countries around the world.

**Q10 What examples of good practice from regulatory regimes in other industries/sectors that are dependent on high quality safety environments are there that we could learn from? What key lessons are there for enhancing fire safety?**

**Regulatory system**

73. A number of sectors have been highlighted as having elements of their regulatory systems that could be valuable to consider in review of the building and fire safety regulatory system. These are outlined below at a reasonably high level. We would be happy to collate and provide further information from relevant experts within the Academy's Fellowship or across the engineering community in relation to these sectors if required.

74. **Health and safety at work; a systems approach** – The Robens report of industrial health and safety from the 1970s<sup>21</sup> was an important review that took a systems approach to consider many of the same issues as this review of building regulations and fire safety, including legislation, roles and responsibilities, and competence and capacity. This review led to an overhaul of the regulation, and has generated a regulatory system that functions well and is well-respected across industry and regulators. A number of lessons can be learned from this process, including how the boundaries of the system were defined, how different elements of the system (including the sector and regulator) were integrated and worked together, and the challenges that were faced during this process of change<sup>22</sup>.

Elements of the regulation of health and safety at work that work well, and that could inform changes to regulation of the building sector, include:

- A single primary piece of legislation with more specific legislation and guidance cascading down from the primary legislation
- A strong emphasis on risk assessment by competent individuals, with the aim of reducing risk as low or as far 'as reasonably practicable'
- A strong enforcement system with independent regulators who have authority to use a range of sanctions to ensure compliance (including non-judicial and judicial sanctions), but who generally work alongside the sector with the shared aim of improving safety.

---

<sup>21</sup> *Safety and health at work. Report of the committee 1970-72* Chairman Lord Robens. July 1972

<sup>22</sup> *A Systems-based Approach to Health and Safety Regulation: Analysis, Experience and Results of the 1974 Reform of UK Administration*. Rimington and McQuaid. 2013

This health and safety regulatory system depends strongly on competence and capacity, including technical and regulatory expertise, in both the industrial sector and the regulator. Additionally, its success depends upon close and effective working between policymakers and technical experts across the sector<sup>22</sup>.

75. **Dams and reservoirs; integrating expert assessment** – Enforcement of the Reservoir Act in this sector depends upon review by a panel system of qualified engineers appointed by the Secretary of State at Defra and convened by the Institution of Civil Engineers<sup>23</sup>, working alongside the relevant government department. This is an interesting model for integrating the key role of technical experts in regulation and enforcement that may be interesting to consider in relation to buildings and fire safety.
76. **Oil and gas sector; learning from incidents** – A key feature of the oil and gas sector that may provide lessons for the building sector is the processes developed to facilitate learning and improvement following incidents. The Energy Institute has developed a range of resources<sup>24</sup> that support the investigation of incidents focusing on human factors, understanding the whole system in which a person is working, their perceptions or beliefs and how their environment and past experiences influence an incident. These areas help investigators understand the underlying causes *beyond* engineering or 'who did what', uncovering systemic issues. These tools could be adapted to be of use in the building sector, particularly in conjunction with work to improve the safety culture and transparency of the sector (see question 5, paragraphs 60-61).
77. **Highway Structures; Technical Assurance** – The quality control and enforcement process of the construction and maintenance of highway structures (bridges and tunnels) is considered to work well and could serve as a model for building and fire safety regulation. Firstly, initial designs are reviewed and approved as part of an Approval in Principle Document. Secondly, competent persons are required to confirm that construction has been conducted to the design as in this document, or to approve any changes made to the design. This is also reviewed by the control authority. Finally, the Principal Contractor signs a Construction Compliance Certificate to confirm that the works have been carried out in accordance with the agreed technical approval. This certificate is also counter-signed by a third party.
78. **Military aviation; understanding responsibilities** – The responsibilities of the military aviation community are well defined under the Military Aviation Authority's Regulatory Publications Regulatory Articles. However, understanding of these responsibilities throughout the sector could be improved, and Defence Equipment and Support are exploring how to develop this understanding. There may be lessons from this process that may be relevant for the building sector. Another key point from this sector is the clear organisational separation between the sector (Defence Equipment and Support) and the regulator (the Military Aviation Authority) which is considered an important part of effective regulatory oversight.

### Fire safety in other sectors

79. Key features of fire safety systems in high-risk sectors are flexibility and resilience. For example, in the mining sector a minimum of two routes of access and egress from underground are always required, unless the number of people involved is very small (under ten). In addition, underground employees are frequently supplied with

---

<sup>23</sup> The ICE Reservoirs committee <https://www.ice.org.uk/careers-and-training/careers-advice-for-civil-engineers/specialist-professional-registers/all-reservoir-engineers-and-supervising-engineers> Accessed 05/10/17

<sup>24</sup> Energy Institute resources including: *Learning from incidents, accidents and events*. 2016; *Human factors training* Accessed 10/10/2017; *Tripod methodology* Accessed 10/10/2017.

lightweight portable breathing equipment for use in fire, giving two to four hours of protection from smoke, and providing resilience and protection in case of blocked escape routes.

80. A further example of good practice in some sectors is the training of local leaders who can provide direction and instruction in case of emergency. For example, a small number of residents in high-rise residential buildings could receive basic training to lead become 'resident fire wardens' and provide direction for other residents in the case of fire. However, it should be noted that in commercial properties where this practice is more common, there can be challenges around the ability of wardens to exercise authority.
81. In offshore oil and gas sectors, a wide range of fire safety codes from different associations are used for ensuring the fire safety of different elements of the building project, such as pipe flanges, pipe welding, design of the pressure system where the pipe is used, and the coating system, as no one source of codes covers all elements of the system. Similarly, for buildings, it may be useful to review the wide range of codes produced by different organisations, and collate the relevant guidance provided.

## **Appendix**

This is a cross-engineering sector response, produced on behalf of Engineering the Future, an alliance of the 38 professional engineering bodies in the UK.

The response was led by the Royal Academy of Engineering with active input or review from:

British Institute of Non-Destructive Testing  
Chartered Institution of Building Services Engineers  
Chartered Institution of Highways & Transportation  
Energy Institute  
Engineering Council  
Institute of Healthcare Engineering and Estate Management  
Institute of Marine Engineering, Science and Technology  
Institution of Chemical Engineers  
Institution of Civil Engineers  
Institution of Engineering and Technology  
Institution of Engineering Designers  
Institution of Gas Engineers and Managers  
Institute of Measurement and Control  
Institution of Mechanical Engineers  
Institution of Royal Engineers  
Institution of Structural Engineers

Input was also drawn from a roundtable meeting held prior to publication of the review's call for evidence, with attendance from the following professional engineering bodies in addition to those listed above:

Chartered Institute of Plumbing and Heating Engineering  
Institution of Fire Engineers  
The Welding Institute

The following institutions make up the Engineering the Future alliance:

BCS – The Chartered Institute for IT  
British Institute of Non-Destructive Testing  
Chartered Institution of Building Services Engineers  
Chartered Institution of Highways & Transportation  
Chartered Institute of Plumbing and Heating Engineering  
Chartered Institution of Water and Environmental Management  
Energy Institute  
Engineering Council  
EngineeringUK  
Institution of Agricultural Engineers  
Institution of Civil Engineers  
Institution of Chemical Engineers  
Institute of Cast Metals Engineers

The Institution of Diesel and Gas Turbine Engineers  
Institution of Engineering Designers  
Institution of Engineering and Technology  
Institution of Fire Engineers  
Institution of Gas Engineers and Managers  
Institute of Highway Engineers  
Institute of Healthcare Engineering & Estate Management  
Institution of Lighting Professionals  
Institute of Marine Engineering, Science and Technology  
Institution of Mechanical Engineers  
Institute of Measurement and Control  
Institution of Royal Engineers  
Institute of Acoustics  
Institute of Materials, Minerals and Mining  
Institute of Physics  
Institute of Physics & Engineering in Medicine  
Institution of Railway Signal Engineers  
Institution of Structural Engineers  
Institute of Water  
Nuclear Institute  
Royal Academy of Engineering  
Royal Aeronautical Society  
Royal Institution of Naval Architects  
Society of Operations Engineers  
Society of Environmental Engineers  
The Welding Institute