THE COST OF FIRE IN HIGH RISE BUILDINGS: POST GRENFELL AND IMPLICATIONS FOR THE PROFESSIONAL DEVELOPMENT OF THE QS.

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Abstract

The recent Grenfell tower fire disaster in 2017 and Hackitt Review heightened the need to address the issues of fire safety regulations. However, increasing pressure to reduce building costs and to complete construction projects on time remains a major challenge. This study examines the cost of fire in high rise building projects and the implications for the professional development of quantity surveyors (QS). The methodology adopted is a case study approach drawing on the recent experience of the Grenfell tower fire disaster of 2017, an analysis of data collected on fire provision in high rise buildings using the BCIS database and a review of the RICS New Rules of Measurement (NRM). Given the significant cost of fire in high rise buildings, there is a need for adequate provision in fire protection by investing in costs in anticipation of fire during cost planning stages to significantly reduce the costs associated with the consequence and responses after a fire incident estimated to be extremely high in the case of Grenfell. The QS need to move away from ad hoc approaches adopted in pricing items specific to fire protection as part of a team of professionals and developing the required competencies will significantly reduce the risk of not pricing adequately for fire provision in the cost plan.

Keywords: Grenfell fire, Hackitt review, cost of fire.

INTRODUCTION

The annual cost of fire to the UK economy was estimated to be £8.3 billion in 2008 and the financial implications have been increasing over time (The Chartered Institute of Public Finance and Accountancy, 2008 and Department for Communities and Local Government 2011). The number of high-rise buildings in the UK has continued to grow significantly. For example, London has over 435 high rise buildings in its development pipeline for 2016 to 2020, with over 30% in construction (AMA Research, 2017). According to Hall (2011), an average of 15,700 fires per year were reported in high-rise buildings in the USA, causing a total of 53 deaths, 546 injured, and $235 million in direct property damage. The Building Codes create the requirements which every design of a high-rise building must meet and added safety measures are necessary to mitigate against risk inherent in a project and the difficulties in fire-fighting operations (Hall, 2012). International technical guidance from National Fire Protection Association 101 in the U.S. (NFPA 2012), or the Approved Document B (The Building Regulation 2006) in the UK provides information on the design of major buildings and components including high-rise

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buildings. Other countries also have similar standards such as the Code for Fire Protection Design of Tall Buildings in China (GB50045-95 2005), the Fire Safety Requirements for super high-rise residential buildings in Singapore (Singapore Civil Defence Force 2006) or Chapter 7 of the Fire and Life Safety of National Building Code of India (Bureau of Indian Standards, 2005). The UK government has the right to fine companies if they do not adhere to the correct regulation on fire safety standards. The top four fire fines handed out in the UK according to City Fire Protection (2018) are: The Radnor Hotel (£200,000) The Chum Leigh Lodge Hotel (£210,000), The Co-operative (£210,000) and New Look (£400,000).

Many questions have been asked and some remained unanswered following the recent fire incident on Grenfell tower building regarding the adequacy of current safety regulations and emergency procedures for high-rise buildings and it raises serious issues relating to ethics and professionalism. The UK Government commissioned report titled *'Building a Safer Future Independent Review of Building Regulations and Fire Safety: Final Report'* by Dame Judith Hackitt (2018) described how the regulatory system covering high-rise and complex buildings was not fit for purpose. The interim report also established that "a lack of skills, knowledge and experience and a lack of any formal process for assuring the skills of those engaged at every stage of the life cycle of higher risk residential buildings (HRRBs) as a major flaw in the current regulatory system".

But issues of costs have also been part of the on-going debate on fire safety of high-rise buildings, particularly relating to retrofitting existing stock of buildings to make them more fire and safety compliant. During the planning of a high-rise development many factors must be taken into consideration including the roles of the professional and accreditation bodies. The Hackitt Review (2018) noted that the professions in the construction and fire safety sectors "have a key role to play in agreeing and monitoring accreditation and reaccreditation, and the period within which the competence of individuals should be reassessed and reaccredited". This study examines the cost of fire in high rise building projects and the implications for the professional development of the quantity surveyor (QS).

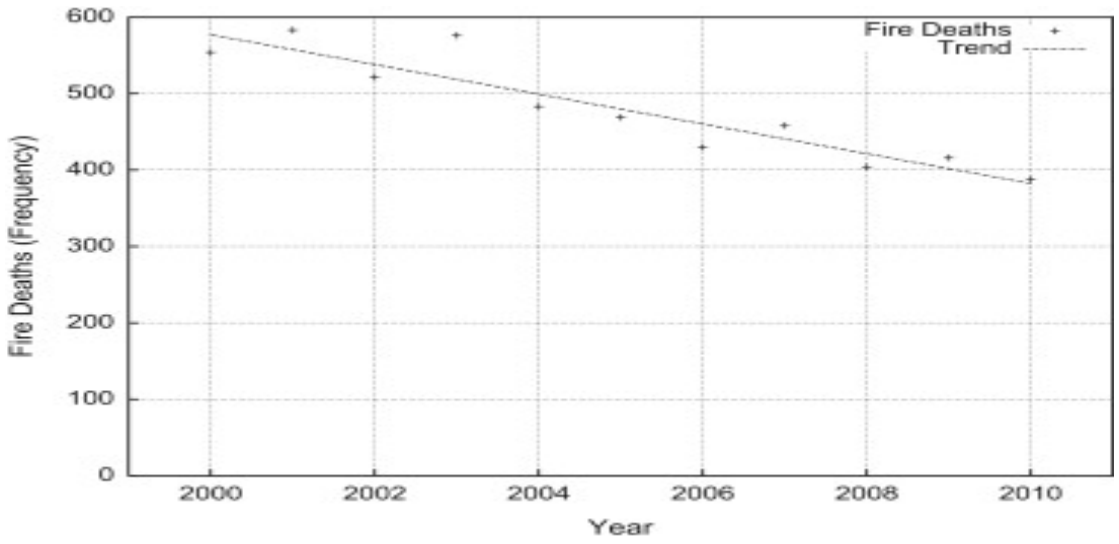
LITERATURE REVIEW

High Rise Buildings and the Cost of Fire

A high-rise building can be defined in many ways with most agreeing that it is a tall encased structure (Quiter,2008). A high rise building can also mean "*buildings greater than 75 feet (approximately 23 m) in height where the building height is measured from the lowest level of fire department vehicle access to the floor of the highest occupiable storey"* (NEPA 2012). Some also define it by height with over thirty-five metres often cited in the literature whilst others use the number of storeys. For example, seven storeys plus was indicated in Hall Jr, (2005). Interestingly, Knoke (2006) defines high rise buildings as "one that extends higher than the maximum reach of available fire-fighting equipment". However, it is generally down to the fire codes in a particular city, country, region or county. Hall (2011) identified the main building uses that can be categorised such as office buildings, residential buildings (e.g., hotels, apartment buildings) and health care facilities. Each of the categories presents different characteristics from the point of view of the infrastructure and the population. The analysis of building use is therefore crucial to predict the possible cost of fire. For example; office high rise buildings typically for commercial and business

activities are considered less hazardous than medical or residential. Office buildings are also split into multiple business uses belonging to various companies. Medical high-rise buildings have living spaces such as hospital beds. The risk for fire is higher than other buildings because of the hazardous nature of the activities including the high cost of medical equipment. Residential high-rise buildings are associated with significant risks because of the nature of activities, kitchens and appliances (Beaudry, 1996). Hotel high buildings comprise of rooms used for business, pleasure, travel and venue hire. Hazards in hotel buildings are generally less than other type of buildings. Whilst fire deaths have fortunately decreased, the costs of fire have been increasing which is a concern for the insurance companies working with the construction industry. The fire deaths from 2001 to 2011 are shown in Fig.1.

Fig.1. UK fire deaths from 2001 to 2011



Source: ((DCLG, 2011))

The costs of fire can be categorised into three areas, *(1) costs in anticipation, (2) costs as a consequence* and (3) c*osts in response* using an approach adopted by Brand and Price's (2000) and González Cabán (2010). *Costs in anticipation* relate to measures put in place *prior to a fire occurring* to prevent and protect possible victims of fire and to reduce the effect of fire damage such as the use of a fire alarm system, sprinklers and insurances. *Costs as a consequence* arise from the impact of fire on property, persons, the environment, private businesses and the public. Wider economic distortions include effects on local communities, markets, discouraging new residents to move in or even new businesses to open in the affected area, time off work and loss to local businesses because of the shutdown following a fire. Other costs according to Brand and Price's (2000) and González Cabán (2010) include environmental costs as a result of the impact a fire can have on landscape and surrounding areas, local wildlife and plants, especially if it is nearer a natural environment, the health implications for surrounding residents such as asbestos burning, carbon dioxide released into the atmosphere which contributes to global warming. Heritage and cultural costs relate to people's belongings, heritage and culture in the form of photos, community infrastructure and cultural networks. *Costs in response* are costs that are related to the putting out of fires, clearing up operation and rebuilding which occurs

afterwards such as removal, replacement or upgrading of existing building components. Some of these costs are absorbed by the public such as the fire and rescue, and emergency services. For example, the residents of a building will need to move out for the authorities to undertake the cleaning and repair damages. In 2008, the UK's GDP was £1466 billion, and the cost of fire was £8.3 billion broken down as shown in Table 1 below.

Table 1: Cost of Fire

Area	Anticipation (£m)	Consequence (£m)	Response (£m)	Total (£m)
ENGLAND	£3,185	£3,285	£1,807	£8,277

Source: (DCLG, 2011**)**

There was a 43% decrease in fires in purpose-built high-rise flats from 1,261 (in 2009/10) to 714 (in 2016/17). This could be due to many factors, one being the increased technology in fire safety and additional procedures and regulations in place. About 2% of fires in 2016/17 was in high-rise flats (Department for Communities and Local Government, 2017). To minimise the disastrous effects caused by fires in buildings, the UK Government implemented the building regulations i.e. Approved Document B (ADB) with pro-active fire safety initiatives. However, it was highlighted in the recently commissioned Government report that there were serious shortcomings in the planning, design, and construction of buildings. Hackitt Review (2018) described how the regulatory system covering high-rise and complex buildings was not fit for purpose and noted that the lack of a coherent and comprehensive approach to competence can seriously compromise the fire safety of HRRBs. The review further noted that "in other parts of the world, those engaged to work on more complex buildings require a higher degree of competence and expertise – for example through certification and accreditation – than that required for work on small-scale or simple buildings". The report of the Hackitt Review also identified key professions whose work is essential to the fire safety of high-rise buildings. Increased levels of competence are therefore as an integral part of the proposed new regulatory framework.

QS Competencies and the Provision for Fire Safety in Cost Planning

Issues of costs have been part of the on-going discussion of fire safety and the competence of the quantity surveyor is crucial in ensuring that there is adequate provision for fire safety during the cost planning process of high-rise buildings. The New Rules of Measurement (NRM) developed by the Royal Institution of Chartered Surveyors (RICS) is designed to bring consistency to cost management of new construction and maintenance work (Earl, 2012). The NRM is designed to provide a robust framework for the financial management using a structured approach from inception through to post occupation using NRM 1, NRM 2 and NRM 3. There are provisions for fire safety associated with many elements in the NRM. For example, the provision of mechanical and electrical (M&E) services is a significant component of a building's overall cost (Cunningham, 2017). M&E services are broadly classed into sub-elements with 5F designated for Space Heating and Air Conditioning in the cost plan, 5H (Electrical Installations), 5K (Fire and Lightning Protection) and 5L (Communications and Security Installations). The more complex the building, the greater the M&E input that will be required and often the value of M&E can easily

exceed other elements of a building project. For example, M&E costs for traditional buildings has risen from 15 to 30% to between 15 to 70% of the total building costs depending on the sophistication of the services (Rawlinson and Dedman, 2010). It is therefore important at all stages for the quantity surveyor to have a good understanding of the provision for fire so that appropriate costs can be allocated to improve fire safety. Hence, there is a need for robust cost planning procedures at both pre- and post- contract stages of a project to ensure the cost of fire provision is adequately factored in the cost planning process. According to Symonds and Robinson (2015), NRM was introduced to provide a consistent elemental breakdown structure, to enhance the measurement rules and to strengthen the link with the nature of contractor organisational structures and construction procurement methods. The new rules use the word 'Mandatory' when describing the information that must be put into a BoQ description. Unlike the SMM7, the new rules allow the measurer to create composite descriptions provided the descriptions make clear what is to be included in the rate (Symonds and Robinson, 2015).

METHODOLOGY

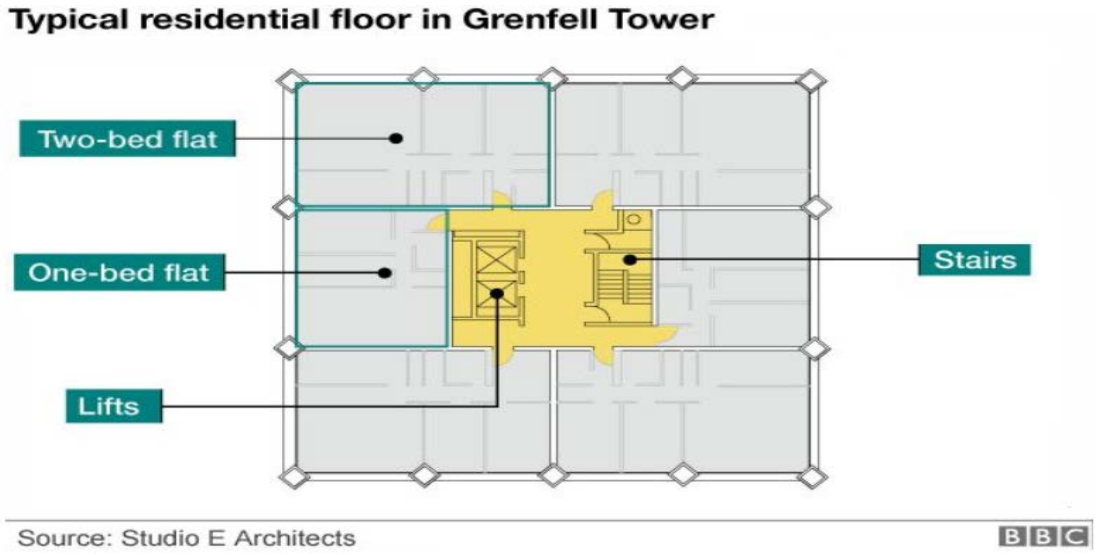
This is part of an on-going study on the provision for fire protection system in the cost planning process. A three-pronged approach was adopted in the study. First, a case-study approach was developed based on secondary data to help understand how the three key categories of costs can be applied using the Grenfell tower fire disaster to provide context and to analyse the cost associated with fire in terms of *costs in anticipation, costs in response* and *costs as a consequence*. Second, data was collected on completed high rise building projects using the Building Cost Information System (BCIS) database to assess the provision for fire safety in elemental cost plans as part of the costs in anticipation. Third, the provision for fire safety in the New Rules of Measurement was assessed to identify the sections where there is an explicit mention of fire protection as part of the costs in anticipation.

FINDINGS AND DISCUSSIONS

Emerging Issues from Grenfell Tower

Original Design

Grenfell Tower was constructed in the 1970s and consists of four storeys of community and office facilities at the base of the building with 20 storeys of flats above. The building features included an in-situ concrete core and concrete escape stair and lifts in the centre with the flats arranged around the core which is a straightforward and standard form of construction that is widely used today.



Upgrading of Building

The building was refurbished recently including a new heating and cladding system at a cost of £8.6 million Clark, T. (2017). One of the key drivers for the refurbishment was to improve the thermal performance and appearance of the building through the new cladding. The cladding features spandrel panels at cill height with alternating windows and panels above. The windows are a polyester-powder coated aluminium tilt/turn design. The spandrel panels are a rain screen cassette system fixed to the building. Drawings suggest the cassettes feature a timber coloured backing board with insulation - possibly a foam type material - fixed to the panel. There is a ventilated cavity in front of the insulation which drawings suggest is approximately 50mm deep Lane. T. (2017). The cavity features horizontal cavity barriers to prevent the spread of fire. The building is faced with aluminium rain screen panels. A Reynobond aluminium composite panel was specified with two aluminium sheets sandwiching a core material to give the panel its rigidity. According to Reynobond's website (2017) the panels are available in two variants, one with a polyethylene core, which is a type of plastic and a version with a fire-retardant mineral core said to provide higher resistance to fire.

Cause of the Fire

The main areas of concern were: the cause of the fire (later confirmed to be a faulty fridge), claims from residents about long-term fire safety concerns and the speed at which the fire engulfed the building. Tenant Management Organisation (TMO) Health and Safety Officer conducted a fire risk assessment in 2012, which Grenfell Action Group (GAG) published the following year, describing a variety of safety concerns, including fire-fighting equipment not been serviced for up to four years, on-site fire extinguishers that had expired with the word 'condemned' marked on some of them due to their age. GAG WordPress (2016), rt.com (2017). In January 2016, GAG raised concerns that people might be trapped in the tower block by fire because there was only one entrance and exit GAG WordPress (2016). Also, rubbish such as old mattresses was accumulating in the corridors. Later that year, GAG published an online article criticising Kensington and Chelsea Tenant Management Organisation for their attitude and accusing the council of ignoring health and safety laws. Some of the key issues are outlined below.

Highly flammable construction materials was used

The unusual speed at which the fire travelled from the foot of the building to the top floor shocked many onlookers. Attention soon turned to the cladding on the exterior of the tower block which experts suggested may have acted as an accelerant used (Bulman, 2017) Subsequent testing of the cladding material suggests that it is combustible. Fire safety experts are already calling for a ban on the use of combustible materials in the construction of high-rise buildings. The cladding was a huge issue for the fire spreading; it was reported that the cladding was banned in other countries and should have been thoroughly considered before it was used (Bulman, 2017). It was also claimed that only a small expense was required to upgrade the cladding to a fire-resistant version of the material used (Bulman, 2017)

Fire evacuation and the integrity of the building structure was compromised

A 2014 newsletter from KCTMO advised residents that there was an official 'stay put' policy in place in the event of fire. Grenfell Tower Regeneration Newsletter. (2014). It also claimed that the doors to the flats were 30-minute fire rated. A subsequent newsletter in 2016 repeated this information, adding that it was based on the advice of the London Fire Brigade Grenfell Tower Regeneration Newsletter. (2016).

There was no sprinkler system in the building.

Regulations stipulate that all new tall buildings must have sprinkler systems, but this does not apply retrospectively to older buildings. Grenfell Tower did not have a sprinkler system from its original build and it did not have one installed during refurbishment. The building was built in 1974 where the building regulations did not require the installation of sprinkler systems (Clark, 2017).

The Costs of the Grenfell Fire

Anticipation Cost

The cost of anticipation was considered for the Grenfell Tower. One of the failings that have been commented on is not having a suitable sprinkler system. A sprinkler system is ideal to have in high rises as it can either extinguish a fire or allow more time for evacuation (National Fire Protection Association, 2018). Fitting sprinkler systems are cost effective over other methods of anticipation as it has a higher probability in its performance. (RAD, 2018). It was estimated that it would have cost £200,000 to install a suitable system (Hughes, 2017). Compliance with the current building regulations may have averted the disaster and all its consequences.

Cost as a Consequence

Costs as a consequence of Grenfell is significant due to the number of fatal (80 deaths in total) and non-fatal casualties, property damage and the loss incurred to businesses. Bergin. T (2017). Grenfell Tower did not have an ordinary fire alarm system, which alerts everyone in the building to evacuate as needed. Instead it had a 'stay-put' policy that meant residents were not notified of the fire, so that they did not leave their dwelling and flood communal stairways that emergency services would need for access (O'Neill, 2017). The amount of fatalities and injuries could have been reduced significantly by the building's fire strategy (Hsiung, Chien, & Wu, 2006) and the associated costs would have been lower if prevention methods had been in place. The alarm system that was installed was deemed suitable O'Neill (2017). A generic alarm system may have worked better and allowed more personnel to evacuate keeping the consequence costs down. The chosen method seemed to be cost effective and no need

to lay out extra for this as individual flats were equipped with a cheaper alternative smoke alarms (Mark & Cynthia, 2017). Families were left with facing their loss in a state of bereavement with close family members dying through no fault of their own (Quality Solicitors, 2018). Families have the right to be compensated which will mean a large sum of money to be paid out. Many lawyers and Reuters News are part of the investigation so the total cost for this type of event which has not happened before will lead to significant expenses (Bergin, 2017).

Cost in Response

There are significant costs associated with the response from the fire and emergency services, rehousing the victims of the Grenfell tragedy, fire risks assessment on similar buildings and the public inquiry to find out what happened and to identify agencies accountable for the deaths and damage. After the loss of approximately 80 lives further investigations and actions are being taking to avoid such disasters such as the reviews and fire risks assessment carried out by local authorities. However, post-Grenfell, the London fire chief has called for sprinklers to be retrofitted in all social housing blocks. BBC News (2017). An immediate reaction to Grenfell Tower was to investigate any other similar contracting works involving the same cladding, which was applied to many other high-rise developments in the surrounding area and nationally. The clean-up and repair operation involved for Grenfell Tower is expected to have extraordinary costs with the remains of the building planned to be demolished and a memorial put in place.

The Grenfell Tower is insured for a sum of £20 million, although the cost of the response is rumoured to be near £1 billion (Gangcuangco, 2017). This insurance will provide a guarantee of paying out a specified amount as compensation for each death with the first phase of funding of an initial £20,000 for families of each person who has died or declared missing (Press Association, 2017). Other phases are to follow, as the initial amount is to allow families to start recovering.

Analysis of BCIS Projects for Provision for Fire Protection in Cost Plans

Investing in costs in anticipation of fire can significantly reduce the costs in consequence and responses. Prevention is better than cure as money spent putting measures in place before fire incidents take place will save lives, property and significantly reduce other costs associated with consequences and responses. For example, the sprinkler system in the Grenfell Tower, could have been installed for the cost of £200,000 which would work out to around £2,000 per flat. This is insignificant compared to the cost of the refurbishment including the cladding installation which was £8.6m, equating to around £72,000 per flat or an additional 8% of that sum which could have drastically changed the outcome of the tragedy (Davey, 2017).

However, a common barrier to the costing is the lack of an explicit approach to costing specific items for fire safety provision in the cost plan. Based on 22 projects analysed (See Table ??) from the BCIS database, the cost although it appears insignificant compared to the total building cost was explicitly identified and included within element 5K (Fire and Lightning Protection) for only 4 buildings.

Table 2: Analysis of Fire Provision in Selected Projects

	Location and type	Date	Storey	Floor area in m^2	Cost/m2	Fire Provision / Subsection	Total Cost
1	London N7 / New build	Jul 2016	6	3,863m^2	£1,971	£8,790 / 5K	£7,613,973
3	London E3 / New build	Sep 2014	7	14,799m^2	£1,367	£1,060,876 / 5K	£20,230,233
7	Hampshire / New build	May 2013	6	1,461m^2	£1,064	£9,143 / 5K	£1,554,504

5F (Space Heating and Air Conditioning)

5H (Electrical Installations),

5K (Fire and Lightning Protection)

5L (Communications and Security Installations).

Table 3: No of Storeys in the Buildings.

Six Storey High	Seven Storey High	Eight Storey High	Nine Storey High	Ten Storey High
10	6	1	0	2

Table 4: Gross Floor Area (GFA) of the Buildings.

Less than 5000m2	5000 - 10000 m2	10000 - 15000 m2	15000 -20000 m2	20000 – 25000 m2
9	6	1	0	1

Table 5: Cost per metre Square Area of the Buildings.

500 – 1000 (£)	1000 – 1500 (£)	1500 – 2000 (£)	2000 – 2500 (£)	2500 – 3000(£)	3000 – 3500 (£)
1	9	6	0	1	2

In the remaining buildings, the cost for fire protection was not explicitly stated. In 5 other buildings, it was noted in the cost plans that the cost for sub-element 5K was included ‘elsewhere’ which could be under sub-element 5F (Space Heating and Air Conditioning), 5H (Electrical Installations), or 5L (Communications and Security Installations). However, the amount was not explicitly stated in any part of the cost plan. In another 5 buildings, the cost was included for fire alarm and smoke detector within other sections but again the amount and the specific sections were the cost was allocated was not explicitly stated. In the remaining 6 buildings, the costs for fire protection were not included anywhere. There is an over reliance on ad hoc

approaches that affects the accuracy of costing for fire provision leading to costs that are often unrealistic during cost planning and therefore investing less in costs in anticipation of fire. Recent research also suggests that there are significant gaps in technical knowledge of quantity surveyors and shortages of specialists M&E QS's in the industry to address costs relating M&E sub-elements. The findings suggest there is a need for adequate provision for fire protection in the cost plan and to strengthen the link between NRM 1 and NRM 2

Fire Provision in the New Rules of Measurement 2 (NRM 2)

Analysis of NRM 2 (2013) shows that there is provision for fire protection which is reflected in numerous work sections, of NRM 2, particularly on M&E (see Table ??). See Appendix A for the provision of fire protection in other sections.

Table 6: Analysis of Fire Provision from NRM

	Work Section	NRM Reference	Main Item	Sub-element	Unit	Remarks
33	Drainage above ground	33.4.3.1.1-2 / P228	Pipe sleeves through walls, floors and ceilings	Fire rating	nr	All making good including fire stopping is deemed included Fire stopping to consider
38	Mechanical services	38.9.1.1.1 / P247	Insulation and fire protection		nr / m	pipework/ductwork and associated insulation and fire protection is to be measured inclusive of fittings Unless measured separately all fittings are deemed to be included
		38.10.1 / P248	Alternative 1 – Insulation and fire protection to pipe fittings		nr	
		38.11.1/ P248	Insulation and fire protection to pipe ancillaries		nr	
		38.12.1.1/ P248	Insulation and fire protection to		m^2	

			ventilation ducts			
		38.13.1 / P248	Alternative 1 – Insulation and fire protection to duct fittings			
		38.14.1 / P248	Insulation and fire protection to equipment		m^2	
		38.15.1 / P249	Fire stopping		Nr	
39	Electrical Services	39.3.1.1 / P251	Cable containment	Inclusive of fire barriers and the like	M	
		39.9.1.1 / P252	Busbar	Inclusive of fire barriers and the like	M	
		39.10.1 / P252	Alternative 1 – busbar fittings	Inclusive of fire barriers and the like	nr	
		39.13.1 / P253	Fire stopping and other associated fire protect work		nr	
40	Transportation	40.1.5.1.1 / P254	System	System supplied will include fire alarm and the like	Item	
		40.2.1/ P255	Fire stopping and		nr	

			other associated fire protect work			
41	Builder's work in connection with mechanical, electrical and transportation installation	41.3.1.1.1-3 / P256	Pipes and duct sleeves	Fire rating stated	nr	Fire compartmentation must be shown on the drawings

However, there is a need for further study to determine whether the existing provisions for fire safety in NRM is sufficient for an informed estimation and how the practices of professional quantity surveyors and estimators affect the cost allocated for fire safety provision in high rise buildings. This could increase the cost for professional services, the cost of development for clients, and builders working on high-rise buildings. Following the Grenfell tragedy there has been a significant demand for contractors who provide fire protection services and products, and, in some cases, there has been a fivefold increase in business enquiries (Davey, 2017).

CONCLUSION

Using the cost theory associated with fire, the UK's biggest residential fire, the Grenfell Tower disaster was analysed by breaking down the main aspects of the cost of fire to anticipation, consequence and response costs. The choices made concerning provision for fire protection at the point of redevelopment are obviously questionable. However, the case study using Grenfell Tower has demonstrated that investing in costs in anticipation of fire can significantly reduce the costs in consequence and responses. Prevention is better than cure as money spent putting measures in place for fire protection such as sprinkler system, alarm systems, building components with adequate fire rating, testing and an appropriate fire evaluation strategy before fire incidents will save lives, property, heritage and significantly reduce other costs associated with consequences and responses which in the case of Grenfell is estimated by any account to be extremely high. Analysis of completed projects also revealed that the provision for fire protection in cost plans is not often explicitly stated and there is a need for some reflection to ensure that measures put in place are priced appropriately. There are provisions for fire protection in many sections of the NRM and quantity surveyors should ensure that they are adequately captured and reflected in the tender prices submitted by contractors to improve safety and compliance with current building regulations. Developing the required technical knowledge and competencies of the QS will significantly reduce the risk of not pricing adequately for fire provision in the cost plan and in estimating the cost for building works in high rise development projects.

Appendix A: Analysis of Fire Provision in other sections of NRM

	Work Section	NRM Reference	Main Item	Sub element	Unit	Remarks
14	Masonry	14.25.1.1.1/ P168	Proprietary and individual spot items	Will include fire backs and sides	nr	
15	Structural Metal Work	15. 15.1-4.1-2. 4 / P172	Surface treatment	Fire rating stated	m^2	All preparation deemed included
20	Proprietary linings and partitions	20.8.1.1/ P189	Extra over for access panels		nr	Details include fire rating
		20.16./ P190	Extra over for nonstandard perimeter details		m	Components not used within the main body of work such as fire seals
		20.19.1.1/ P191	Extra over for access panels		nr	Details include fire rating (?)
21	Cladding and Covering	21.12.1-2.1 / P194	Closers	Fire stops	m	
24	Door, Shutters and Hatches	24.1.1-2.1.1-2 / P203	Door sets	Smoke stops Fire stops	nr	Door sets comprise the stops
		24.2.1.1.1/ P203	Doors	Fire resistance performance	Nr	Each leaf of a multi-leafed door is counted as one door
28	Floor, wall, ceiling and roof finishes	28.5.1-2.1/ P214	Fire barriers with void below raised floor	Fire rating	m^2 / m	Fire barriers are deemed to include all support work
29	Decoration	29.1-7.1-3.1-2.5/ P219	Painting	Fire rating	m / m^2 / nr	No further details on fire rating

30	Suspended Ceilings	30.10.1-2.1.1-2 / P221	Fire barriers	Fire rating where required	m / m^2	Fire barriers are deemed to include all support work
		30.11.1-2.1-2.2 / P222	Collars for services passing through fire barriers	Fire rating	nr	Collars are only measured where they are integral with fire barrier
31	Insulation, fire stopping and fire protection	31.7.2.1-5.1-2 / P224	Fire stops. Type stated	Fire rating	m	Fire rating where required is a mandatory information

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