Grenfell Tower – fire safety investigation: The fire protection measures in place on the night of the fire, and conclusions as to:

the extent to which they failed to control the spread of fire and smoke; the extent to which they contributed to the speed at which the fire spread.

Phase 1 Report – Section 12

The significance of the building envelope fire

REPORT OF

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Fire Safety Engineering

24th October 2018

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On behalf of	:	Grenfell Tower Inquiry
On instructions of	:	Cathy Kennedy, Solicitor, Grenfell Tower Inquiry
Subject Matter		To examine the circumstances surrounding the fire at Grenfell Tower on 14th June 2017
Inspection Date(s)	:	6th October, 1st November, 7-9th November 2017

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CONTENTS

12 The significance of the building envelope fire

12.1 Purpose of Section 12

12.1.1 In this Section 12, I describe the significance of the building envelope fire.

12.1.2 I explain the impact the multi storey external fire had on (a) the high degree of compartmentation required to support the Stay Put evacuation strategy; and (b) the high degree of compartmentation required to support the Defend in Place internal firefighting strategy (which also supports the Stay Put evacuation strategy).

12.1.3 I demonstrate why internal firefighting was not the primary response required from LFB, as the fire at Grenfell Tower quickly changed to being one requiring substantial external firefighting.

12.1.4 The external fire, itself caused multiple routes of internal fire spread, as it spread around the four building elevations.

12.1.5 The external fire therefore caused the failure of the internal compartmentation – in the sense the fire spread substantially beyond one flat.

12.1.6 Separately, the internal fires that were ignited and directly caused by the external fire, also caused fire and smoke to spread internally by a variety of different means. I explain this in Section 19 of my Expert Report.

12.1.7 The external fire, and the resulting internal fire scenarios, undermined the principles of Stay Put evacuation, as follows.

12.1.8 Occupants in all flats, other than the expected Flat 16 where the fire started, were not safe to remain, as they were increasingly being directly affected by heat and smoke due to the external fire.

12.1.9 Despite the flats having a high degree of compartmentation, it was not the case there was a low probability of fire spread beyond the flat of origin. The primary reason for this was because the fire was spreading through the rainscreen cladding system which was connected to every flat in Grenfell Tower.

12.1.10 The secondary reason for this was the internal fire and smoke spread from the flats out to the protected lobbies - those internal fires were caused by the main external fire scenario.

12.1.11 How those internal fires then caused the spread of smoke and fire into the lobbies is then of considerable importance, due to the total reliance on the single staircase for evacuation and for fire fighting.

12.1.12 Therefore, this meant it was not the case that a simultaneous evacuation of Grenfell Tower was "*unlikely to be necessary*", as the Stay Put strategy requires. The increasing number of internal fires, the smoke and flame being produced by the rainscreen cladding external fire, the resulting breaching of lobbies by this smoke and fire, was placing ever increasing and substantial

pressure on the active and passive fire protection systems within Grenfell Tower. This was a scenario for which some of those systems were not designed. I deal with each of the active and passive fire protection measures in that context in Section 19 of my Expert Report.

12.1.13 The very basis of the provisions made to ensure that a fire is contained within the flat of origin, and that common escape routes and stairs remain relatively free from smoke and heat in the event of a fire within a dwelling, was now totally undermined by the spreading external fire.

12.1.14 I have provided an analysis of photographic evidence taken during the Grenfell Fire of the external and internal fire spread, and this analysis and my resulting opinions are presented here in this Section 12.

12.1.15 Since drafting my interim report, I have been provided with further videos of early fire spread in the form of exhibits to witness statements of bereaved, survivor and resident core participants. One of these videos of the fire on the outside of the building shows that the fire spread from Level 4 to Level 5, beyond one flat, by 01:13 (IWS00000050). This allows me to conclude that the internal compartmentation and the principles of the Stay Put evacuation regime, had started to fail by 01:13.

12.1.16 My analysis also allows me to conclude that by 01:21, 8 flats had been impacted by the external fire, and this had risen to 20 flats by 01:26. This allows me to conclude that the internal compartmentation and the principles of the Stay Put evacuation regime had substantially failed by 01:26.

12.1.17 The Stay Put evacuation regime, as I explained in my Opening Presentation (Transcript of oral evidence; Barbara Lane; 18th May 2018; page 29) is the single safety condition provided for through the statutory guidance document Approved Document B and all versions of the British Standards for flats, to date.

12.1.18 The statutory guidance makes no provision within the Building for anything other than a Stay Put strategy (See section 3 of my Expert Report).

12.1.19 The failure at Grenfell Tower of the single safety condition provided by the design and construction requirements for high rise blocks of flats, caused a series of consequences for both the residents and the firefighters.

12.1.20 A critical consequence was the contribution the external fire made to creating multiple internal fires. Based on Figure 12.2, internal fires were visible on at least 4 no. storeys by 01:52, and these progressed around the building – refer to the series for each elevation in Figure 12.12.13 through Figure 12.15 inclusive.

12.1.21 The external fire itself therefore caused multiple routes of internal fire spread as it spread around the four building elevations.

12.1.22 Another consequence was the early and prolonged impact the failure of the building safety condition placed on the operational response mechanisms relied upon by London Fire Brigade.

12.1.23 In the next Section 13 of my report, I derive a timeline of critical events during the Grenfell Tower fire.

12.1.24 While the precise timing and wording of the orders given by the relevant commanders will be a matter for the Chairman to consider (as well as what advice was actually given by Control Room Officers), the existing evidence indicates that at 02.35 Jo Smith instructed the control room officers to change the LFB advice to the occupants of Grenfell Tower from stay put to leave. The available evidence also indicates that at or about 02.47 Assistant Commander Roe, then the Incident Commander, also separately ordered that the advice be changed to leave.

12.1.25 I note here that by 02:47, a minimum of 61 flats had now been impacted by the external flame front. At that time, at least 11 internal fires were visible, as shown in Figure 12.3 (between 02:22 and 02:53).

12.1.26 I conclude this Section 12 by explaining the significance of this for the resulting needs for evacuation, and the resulting needs for firefighting.

12.1.27 This then forms the basis of my analysis of the active and passive fire protection measures in Grenfell Tower.

12.2 The external fire spread and the increasing involvement of flats other than Flat 16

12.2.1 The external walls of Grenfell Tower could not adequately resist the spread of fire over the walls, so once the fire entered the cladding system outside Flat 16, it continued to spread and also caused the involvement of other flats through igniting a series of internal fires, on multiple stories in the Tower.

12.2.2 Because the external wall of Grenfell Tower provided a medium for fire spread it was a risk to health and safety.

12.2.3 In Section 5 of my report, I presented a chronological analysis of the external fire spread around Grenfell Tower through a series of photographs.

12.2.4 I have analysed these photographs, and others taken outside Grenfell Tower during the fire, to calculate which flats were affected by the external flame fronts. I have given known time periods, where I have been able to validate the timing.

12.2.5 As I explained in Section 9 of my report, the particular construction of the external cladding (as well as the infill panels, and the window construction within it), provided multiple pathways for fire spread back into the flats.

12.2.6 My analysis here has therefore focused on the number of flats exposed to external fires.

12.2.7 I provide a timeline of each flat as it is impacted by the external fire, on each elevation in Figure 12.1 to Figure 12.5 inclusive.

12.2.8 In these Figures, I show the external flame spread around Grenfell Tower, highlighting the flats affected by the external flame front, at each time.

12.2.9 These figures include the following information for each time:

(a) Photograph used for analysis;

(b) Cumulative elevation(s) affected by external fire;

(c) Cumulative level(s) affected by external fire;

(d) Cumulative flat(s) affected by external fire;

(e) Diagram visually demonstrating the cumulative flat(s) affected by external fire (red shading).

12.2.10 Within minutes of the fire spreading to the external building envelope outside Flat 16, it spread across multiple levels on the exterior East elevation, of Grenfell Tower. The affected flats were then at high risk of additional internal fire scenarios also.

12.2.11 There is evidence of multiple internal fires burning by 01:44 (refer to Figure 12.7), if not as early as 01:36 (see Figure 12.2 below).

12.2.12 This exposed more and more residents to the effects of fire and smoke.

12.2.13 Additionally, both internal and external firefighting became necessary from an early stage of the fire. I address firefighting in Section 13 and Section 17 of this report.

12.2.14 I provide additional information regarding internal fires in Section 12.3 below.

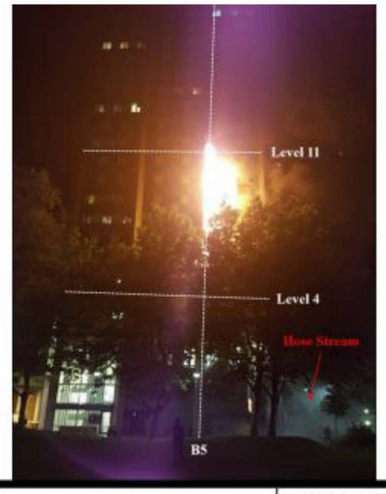
12.2.15 Table 12.1 shows the cumulative number of flats affected by external fire, based on my analysis of photographs in Figure 12.1 to Figure 12.5. There was a total of 129 flats in Grenfell Tower.

12.2.16 As I describe in Section 5, I have now seen evidence showing fire actually spreading to the building envelope by 01:08 at Column B5 (IWS00000051) and that is the basis for the starting time in Table 12.1 below.

Table 12.1: Cumulative number of flats affected by flame fronts

Time	Cumulative number of flats affected by flame fronts
01:08	1
01:21	8
01:26	20
01:36	20
01:52	26
02:10	34
02:23	53
02:34	56
02:53	61
03:09	70
03:21	73
03:43	92
04:03	98
04:31	103
04:44	106

Time	01:08 (IWS00000051)
Building elevation(s) affected by fire	East
Level(s) affected by fire	4
Flat(s) affected by fire	
16	



Time	01:21 (MET00006591)
Building elevation(s) affected by fire	East
Level(s) affected by fire	4 - 12
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86	

Time	01:26 (YouTube)
Building elevation(s) affected by fire	East
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86, 96, 106, 116, 126, 136, 146, 156, 166, 176, 186, 196, 206	

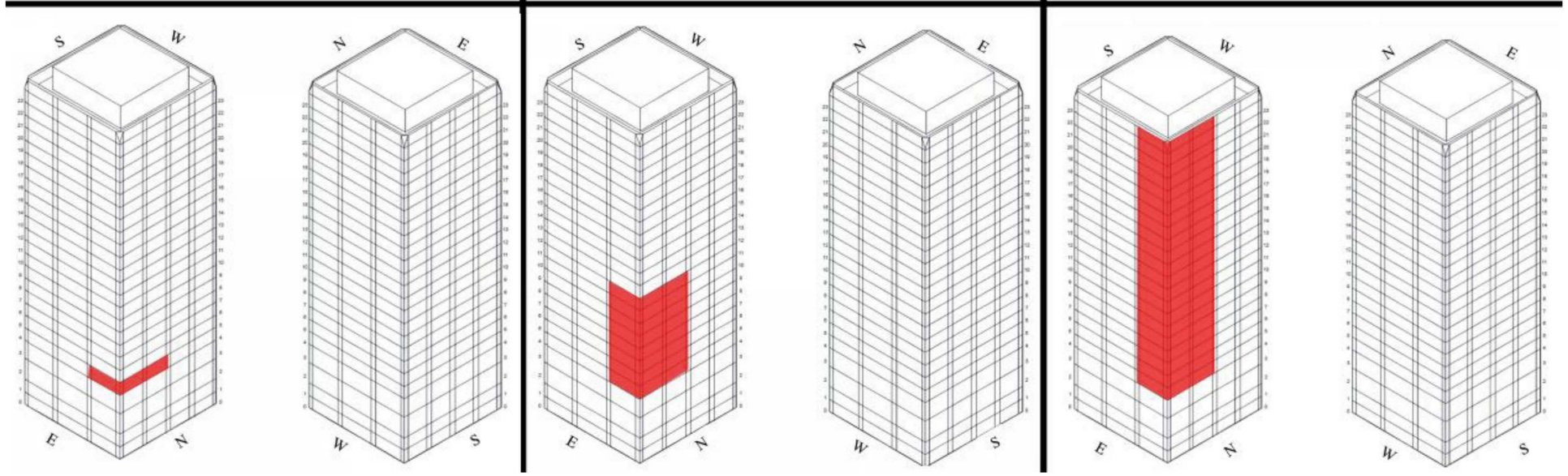
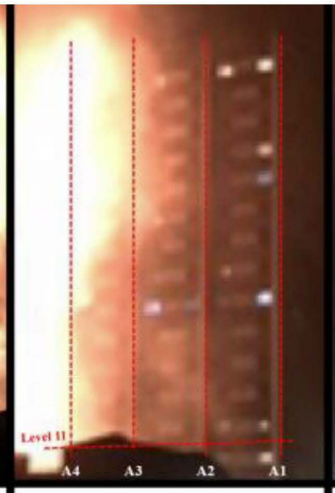


Figure 12.1: External fire spread on the East elevation of the building envelope and the impacted flats, between 01:08,and 01:26 (IWS00000051, MET00006591)[1]

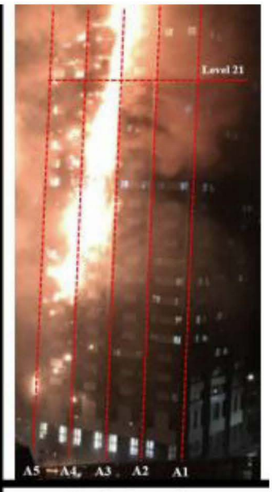
[1] https://www.youtube.com/watch?v=6AYUZ5Snxzo

East elevation
01:52



North elevation
01:53

East elevation
02:09



North elevation
02:10

Time	01:36 (YouTube)
Building elevation(s) affected by fire	East
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86, 96, 106, 116, 126, 136, 146, 156, 166, 176, 186, 196, 206	

Time	01:52 & 01:53 (MET00012593)
Building elevation(s) affected by fire	East & North
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86, 96, 106, 116, 126, 136, 146, 151, 156, 161, 166, 171, 176, 181, 186, 191, 196, 201, 206	

Time	02:09 & 02:10 (MET00012593)
Building elevation(s) affected by fire	East & North
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86, 96, 106, 116, 126, 136, 141, 146, 151, 156, 161, 166, 171, 172, 176, 181, 182, 185, 186, 191, 192, 195, 196, 201, 202, 205, 206	

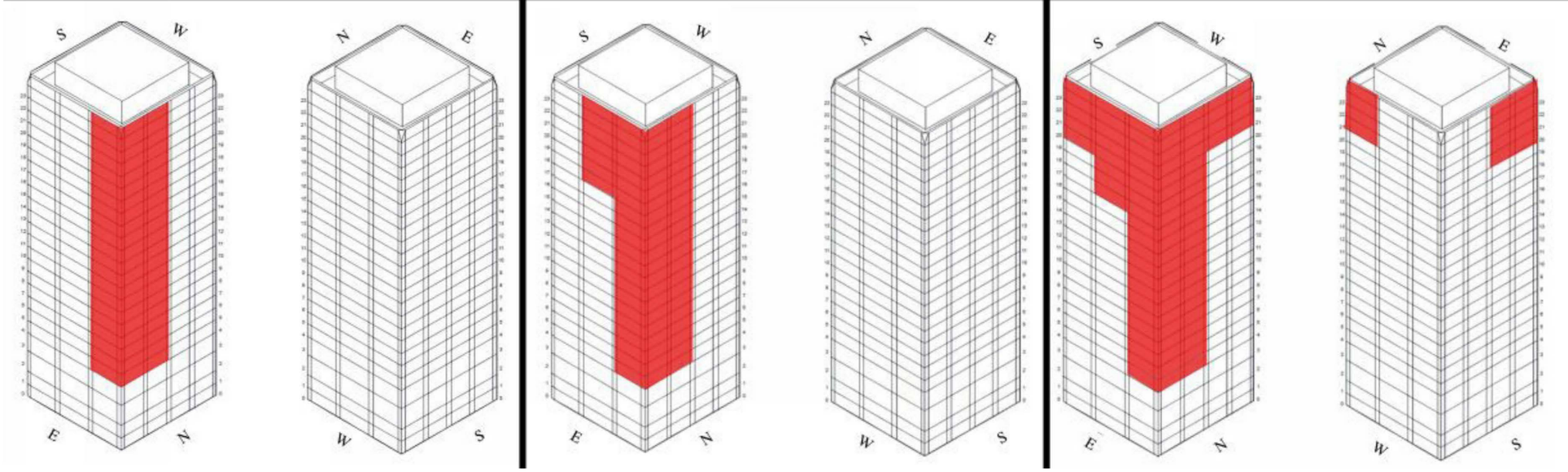
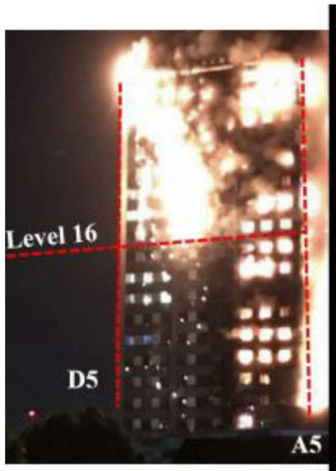


Figure 12.2: External fire spread on the East and North elevations of the building envelope and the impacted flats, between 01:36 and 02:10 (MET00012593)[2]

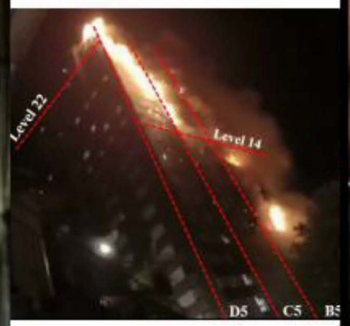
[2] , https://www.youtube.com/watch?v=bBCnQvxNaDg



East elevation
02:22

Time	02:22 & 02:23 (MET00012593)
Building elevation(s) affected by fire	East & North
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86, 91, 95, 96, 101, 105, 106, 111, 115, 116, 121, 122, 125, 126, 131, 132, 135, 136, 141, 142, 145, 146, 151, 152, 155, 156, 161, 162, 165, 166, 171, 172, 175, 176, 181, 182, 185, 186, 191, 192, 195, 196, 201, 202, 205, 206	

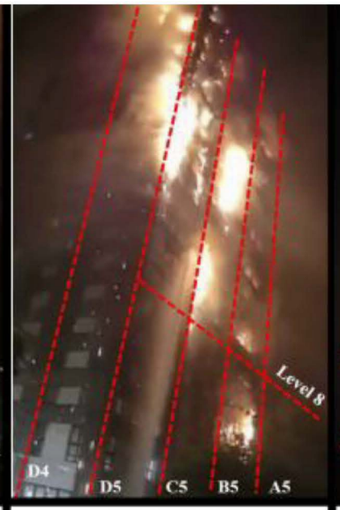
North elevation
02:23



South & East elevations
02:33

Time	02:33 & 02:34 (MET00012593)
Building elevation(s) affected by fire	East & North & South
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 56, 66, 76, 86, 91, 92, 95, 96, 101, 102, 105, 106, 111, 112, 115, 116, 121, 122, 125, 126, 131, 132, 135, 136, 141, 142, 145, 146, 151, 152, 155, 156, 161, 162, 165, 166, 171, 172, 175, 176, 181, 182, 185, 186, 191, 192, 195, 196, 201, 202, 205, 206	

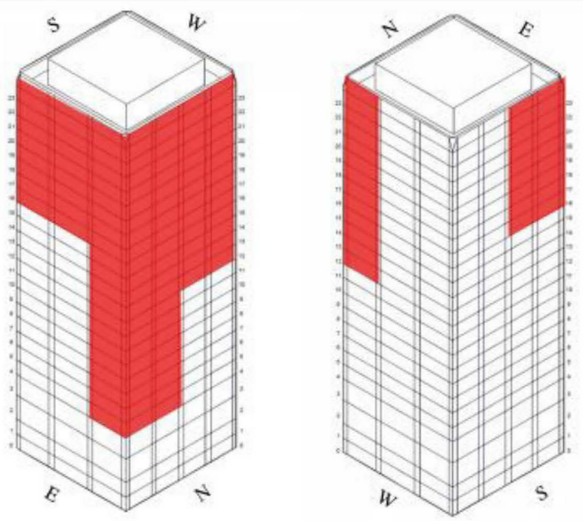
North elevation
02:34

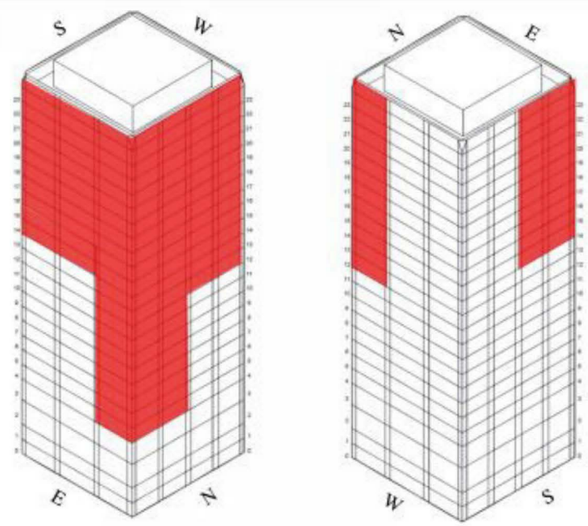


South & East elevations
02:53

Time	02:53 (MET00012593)
Building elevation(s) affected by fire	East & North & South
Level(s) affected by fire	4 - 23
Flat(s) affected by fire	
16, 26, 36, 46, 51, 56, 61, 66, 71, 76, 81, 82, 86, 91, 92, 95, 96, 101, 102, 105, 106, 111, 112, 115, 116, 121, 122, 125, 126, 131, 132, 135, 136, 141, 142, 145, 146, 151, 152, 155, 156, 161, 162, 165, 166, 171, 172, 175, 176, 181, 182, 185, 186, 191, 192, 195, 196, 201, 202, 205, 206	

East elevation
02:53





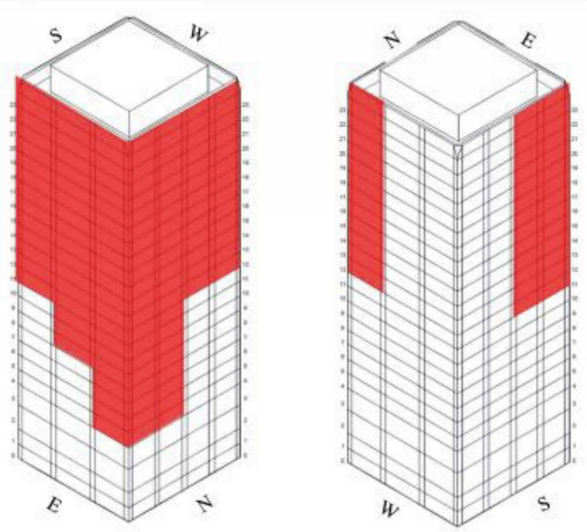
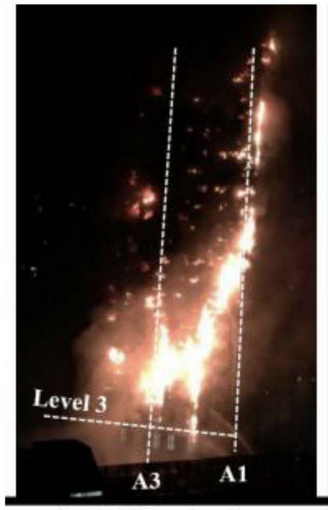
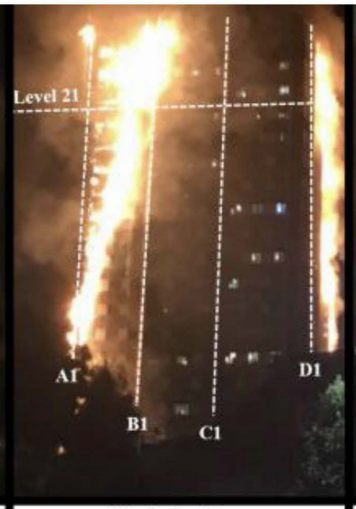


Figure 12.3: External fire spread on the East, North, and South elevations of the building envelope and the impacted flats, between 02:22 and 02:53 (MET00012593)



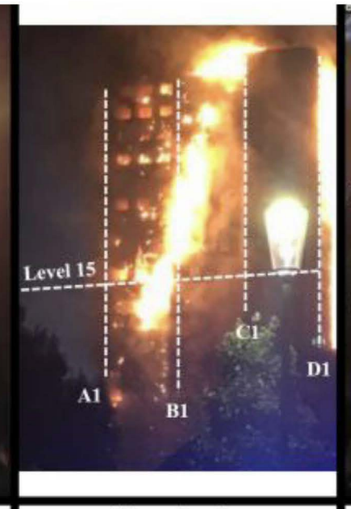
North & West elevations
03:08

South & East elevations
03:09



West elevation
03:20

South elevation
03:21



West elevation
03:42

South elevation
03:43

Time	03:08 & 03:09 (MET00012593)
Building elevation(s) affected by fire	East & North & South & West
Level(s) affected by fire	3 - 23

Flat(s) affected by fire

9, 15, 16, 25, 26, 35, 36, 45, 46, 51, 55, 56, 61, 65, 66, 71, 75, 76, 81, 82, 85, 86, 91, 92, 95, 96, 101, 102, 105, 106, 111, 112, 115, 116, 121, 122, 125, 126, 131, 132, 135, 136, 141, 142, 145, 146, 151, 152, 155, 156, 161, 162, 165, 166, 171, 172, 175, 176, 181, 182, 185, 186, 191, 192, 195, 196, 201, 202, 205, 206

Time	03:20 & 03:21 (MET00012593)
Building elevation(s) affected by fire	East & North & South & West
Level(s) affected by fire	3 - 23

Flat(s) affected by fire

9, 15, 16, 25, 26, 35, 36, 45, 46, 51, 55, 56, 61, 65, 66, 71, 75, 76, 81, 82, 85, 86, 91, 92, 95, 96, 101, 102, 105, 106, 111, 112, 115, 116, 121, 122, 125, 126, 131, 132, 135, 136, 141, 142, 145, 146, 151, 152, 155, 156, 161, 162, 165, 166, 171, 172, 175, 176, 181, 182, 184, 185, 186, 191, 192, 194, 195, 196, 201, 202, 204, 205, 206

Time	03:42 & 03:43 (MET00012593)
Building elevation(s) affected by fire	East & North & South & West
Level(s) affected by fire	3 - 23

Flat(s) affected by fire

9, 15, 16, 25, 26, 35, 36, 45, 46, 51, 55, 56, 61, 65, 66, 71, 75, 76, 81, 82, 83, 85, 86, 91, 92, 93, 95, 96, 101, 102, 103, 105, 106, 111, 112, 113, 115, 116, 121, 122, 123, 124, 125, 126, 131, 132, 133, 134, 135, 136, 141, 142, 143, 144, 145, 146, 151, 152, 153, 154, 155, 156, 161, 162, 163, 164, 165, 166, 171, 172, 173, 174, 175, 176, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 201, 202, 203, 204, 205, 206

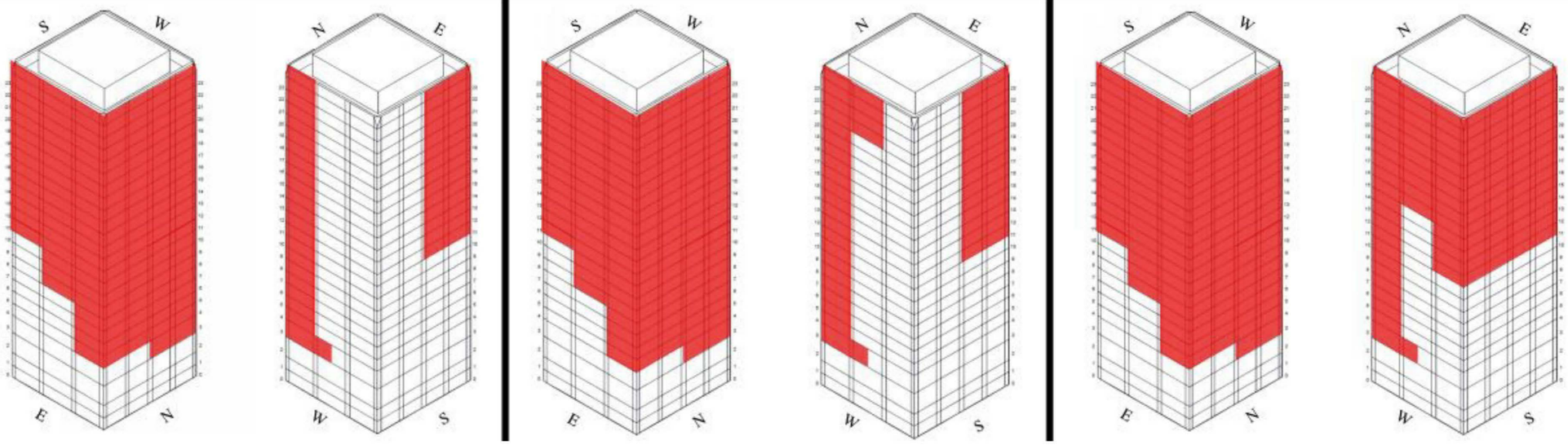
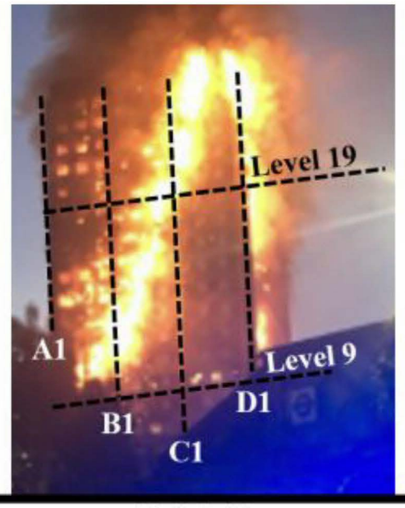


Figure 12.4: External fire spread on the all elevations of the building envelope and the impacted flats, between 03:08 and 03:43 (MET00012593)

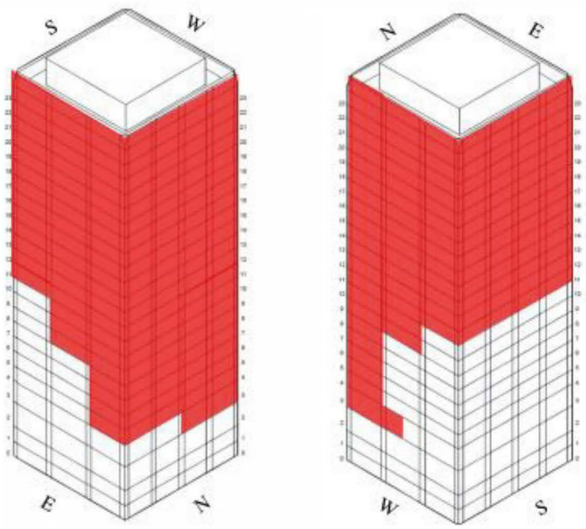


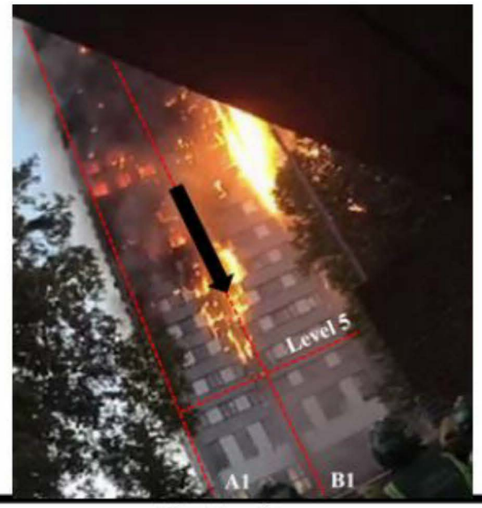
West elevation
04:03

Time	04:03 (MET00012593)
Building elevation(s) affected by fire	East & North & South & West
Level(s) affected by fire	3 - 23

Flat(s) affected by fire

9, 15, 16, 25, 26, 35, 36, 45, 46, 51, 55, 56, 61, 64, 65, 66, 71, 74, 75, 76, 81, 82, 83, 84, 85, 86, 91, 92, 93, 94, 95, 96, 101, 102, 103, 104, 105, 106, 111, 112, 113, 114, 115, 116, 121, 122, 123, 124, 125, 126, 131, 132, 133, 134, 135, 136, 141, 142, 143, 144, 145, 146, 151, 152, 153, 154, 155, 156, 161, 162, 163, 164, 165, 166, 171, 172, 173, 174, 175, 176, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 201, 202, 203, 204, 205, 206



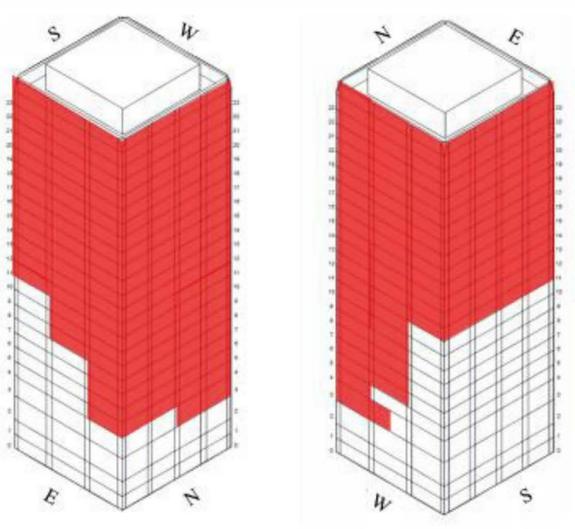


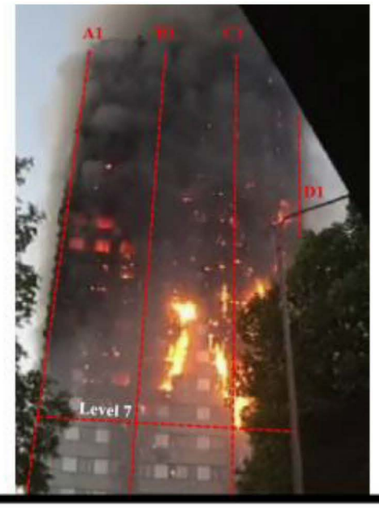
West elevation
04:31

Time	04:31 (MET00012593)
Building elevation(s) affected by fire	East & North & South & West
Level(s) affected by fire	3 - 23

Flat(s) affected by fire

9, 15, 16, 24, 25, 26, 34, 35, 36, 44, 45, 46, 51, 54, 55, 56, 61, 64, 65, 66, 71, 73, 74, 75, 76, 81, 82, 83, 84, 85, 86, 91, 92, 93, 94, 95, 96, 101, 102, 103, 104, 105, 106, 111, 112, 113, 114, 115, 116, 121, 122, 123, 124, 125, 126, 131, 132, 133, 134, 135, 136, 141, 142, 143, 144, 145, 146, 151, 152, 153, 154, 155, 156, 161, 162, 163, 164, 165, 166, 171, 172, 173, 174, 175, 176, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 201, 202, 203, 204, 205, 206





West elevation
04:44

Time	04:44 (MET00012593)
Building elevation(s) affected by fire	East & North & South & West
Level(s) affected by fire	3 - 23

Flat(s) affected by fire

9, 15, 16, 24, 25, 26, 34, 35, 36, 43, 44, 45, 46, 51, 53, 54, 55, 56, 61, 63, 64, 65, 66, 71, 73, 74, 75, 76, 81, 82, 83, 84, 85, 86, 91, 92, 93, 94, 95, 96, 101, 102, 103, 104, 105, 106, 111, 112, 113, 114, 115, 116, 121, 122, 123, 124, 125, 126, 131, 132, 133, 134, 135, 136, 141, 142, 143, 144, 145, 146, 151, 152, 153, 154, 155, 156, 161, 162, 163, 164, 165, 166, 171, 172, 173, 174, 175, 176, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 201, 202, 203, 204, 205, 206

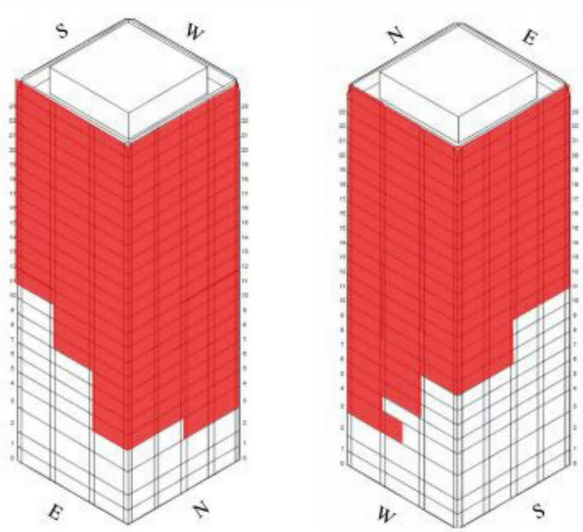


Figure 12.5: External fire spread on the all elevations of the building envelope and the impacted flats, between 04:03 and 04:44 (MET00012593)

12.3 The increasing number of internal fires

12.3.1 By 01:26, fire affected the external building envelope outside "Flat 6" from Level 4 through Level 23, as shown in Figure 12.6.

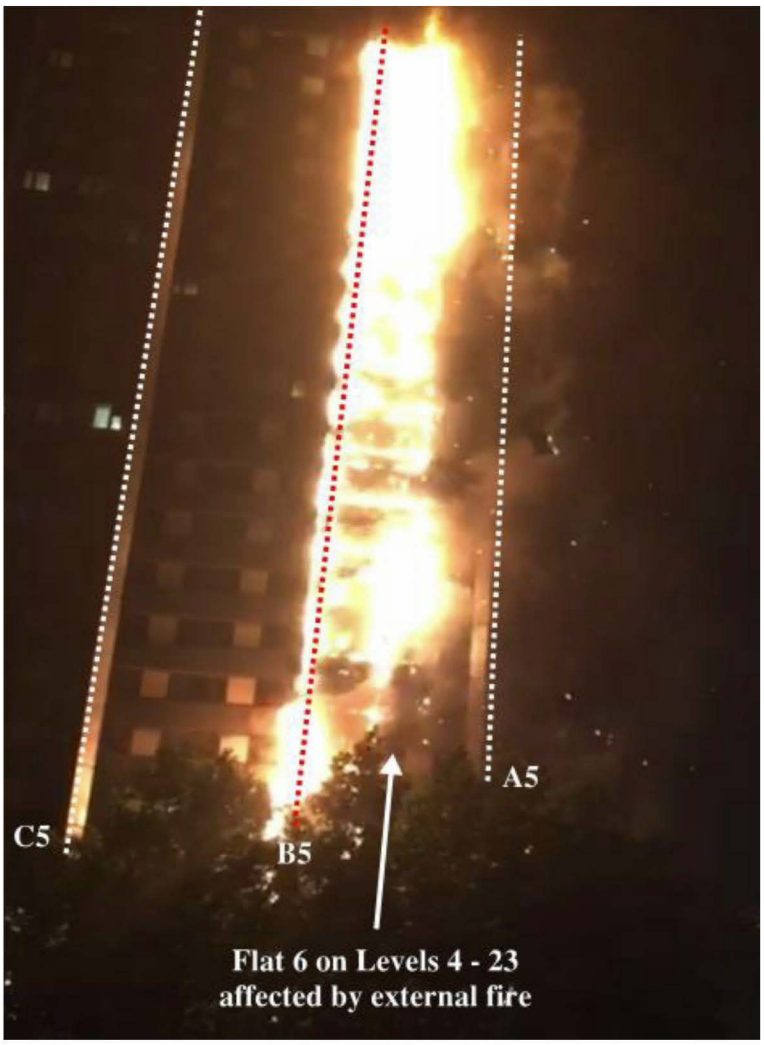


Figure 12.6: Flat 6 on Levels 4 - 23 affected by external fire at 01:26 (IWS00000046)

12.3.2 It can be difficult to differentiate between external fires and internal fires in photographic and video evidence, especially if the flame front is directly in front of a flat with an internal fire.

12.3.3 Figure 12.7 shows the earliest photographic evidence I have seen where internal fires are distinguishable, at 01:44.

Figure 12.7: My first observation of internal fires at 01:44 on the East elevation of building envelope (extract from Bisby Video 2 accompanying Luke Bisby's supplemental phase 1 Report)

12.3.4 Witness statements of residents and firefighters indicate there were internal fires in flats other than Flat 16 before 01:44.

12.3.5 I have investigated the 999 calls recorded MET00014452 and their associated LFB or LAS transcripts and witness statements from residents who evacuated the Grenfell Tower prior to 01:40 for evidence of internal fires occurring before this time.

12.3.6 I have found evidence of internal fire witnessed or reported in 13 flats in Grenfell Tower, the collated evidence is presented in Table 12.2. The times presented are not precise times of when fire spread into flats. They are based on either the time an internal fire was reported by a 999 emergency call or the witness exited the building based on the CCTV exit time.

12.3.7 Therefore, the observations in all cases have occurred no later than the times listed in Table 12.2.

12.3.8 I have included a typical residential floor plan in Figure 12.8 to provide orientation and present the relative position of flat numbers, and with Flat 16, as relied upon in Table 12.2.

12.3.9 Nine of the internal fires are 'Flat 6's – that is, flats located directly above Flat 16 where the fire started. These fires are observed or reported between 01:14 and 01:30.

12.3.10 Two are 'Flat 1' which directly adjoins the kitchen window of 'Flat 6' on the East elevation of Grenfell Tower where the external fire started – these fires are reported on the 11th and 22nd floor at 01:33 and 01:32 respectively.

12.3.11 Two are 'Flat 5' which directly adjoins the 'Flat 6' on the North elevation of Grenfell Tower. These fires were reported on the 12th and the 14th floors at 01:27 and 01:29 respectively.

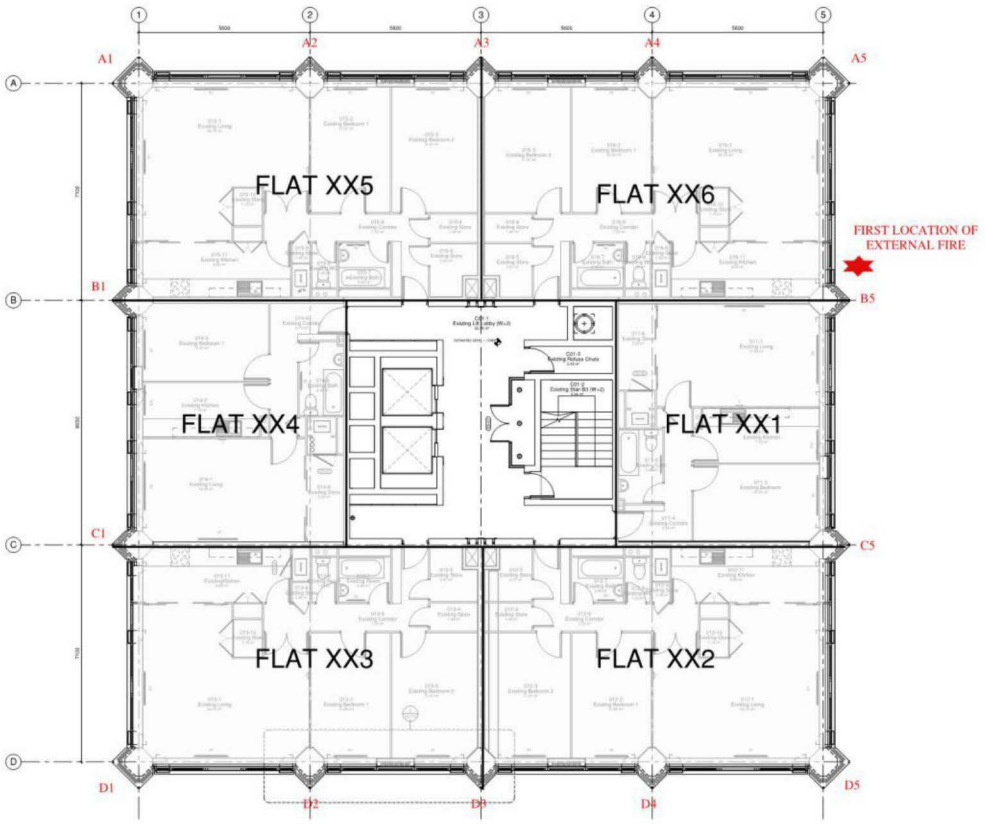


Figure 12.8 Typical floor plan of Grenfell Tower – showing relative positions of each flat (SEA00010474)

Table 12.2 Evidence of internal fires between 00:54 and 01:40 collated from transcripts of 999 calls, survivor witness statements and oral evidence. The evidence is presented in chronological order of when fires were reported.

Location of internal fire report		**Time of report internal fire (bold** denotes CCTV exit time)	**LFB incident number**	**Witness**	**Description**	**Source**
Flat	**Level**					
46	7	**01:14**		Jose Viero	*"The first thing I noticed burning was the extractor"*	**Description:** IWS00001122, Oral evidence 17 Oct Day 59 (Pgs 129- 141) **Time;** CCTV evidence of leaving flat (INQ00000461)
86	11	**01:22**		Nadia Jafari	*"The fire came through the small circular vent at the top of the window"*	Description: IWS00000683 Time: CCTV building exit time (MET000080463)
56	8	**01:24**		Shantilal Patel	*"the vent simply fell into the kitchen and thick black smoke started to pour in to the flat. The extractor fan was made from ordinary plastic, and it just melted under the heat"*	**Description:** IWS00000798 **Time:** CCTV building exit time (MET000080463)
96	12	01:24	076047-14062017	Damiana Louis	999 caller reports fire within her kitchen	**Description**: LFB00000304 **Time**: LFB00004695
186	21	01:26	076052-14062017	Helen Gebremeskel	999 caller reports fire in Flat 186.	**Description** LFB00000306, **Time**: LFB00004695
95	12	01:27	076062-14062017	Katarzyna Dabrowska	999 caller reports *'fire coming through the window'*.	**Description** LFB00000309 **Time**: LFB00004695
156	18	01:27	CAD 537	Shahid Ahmed	BT operator believes could hear banging and people saying fire and an alarm. *"I got the kitchen and looked down out of the window I saw a big fireball coming up from the outside of the building. It was the colour of a burning sunset. I initially thought it must have been a fire in the flat below. The kitchen window then exploded inwards."*	**Description** INQ00000263, IWS00000388 **Time**: INQ00000263
115	14	01:29	CAD 543	Zainab Deen	999 caller reports fire coming into her flat.	**Description** INQ00000270 **Time**: INQ00000270
176	20	01:30	076096-14062017	Jessica Urbano-Ramirez	999 call from Flat 201 Level 23. Caller reports left her flat where kitchen was on fire.	**Description** LFB00000507 **Time**: LFB00004695
196	22	01:30	076063-14062017	Mariem Elghwary	999 call from Level 205; Reports that *'it's broken into our kitchen'*. Caller is resident of Flt 196 on Level 22.	**Description** LFB00000310 **Time**: LFB00004695
176	20	01:30	076079-14062017	Farah Hamdan	Resident from flat 175 reports during 999 call fire is *'in my neighbour's'*	**Description** LFB00000314 **Time**: LFB00004695
201	22	01:32	143550-14062017M	Biruk Haftom	999 caller reports smoke coming into the flat & 'windows already burning up'. Hands over to another caller [male] who reports that fire & smoke is coming through the window.	**Description** LFB00000667 **Time**: LFB00004695

Location of internal fire report		Time of report internal fire (bold denotes CCTV exit time)	LFB incident number	Witness	Description	Source
Flat	**Level**					
81	11	01:33	076075-14062017	Abdeselam Sebbar	999 caller reports that the fire is inside his flat ('inside of the room'). [Note – earlier 999 call identifies person in Flat 91- LFB00000305]	**Description** LFB00000312, **Time**: LFB00004695

12.3.12 By 01:52, the fire was spreading laterally along the East elevation and North elevation of the building, along External Flame Spread Route 1 and 2, as explained in Section 5. These two flame fronts affected the exterior of 26 flats by 01:52.

12.3.13 Through photographic evidence, I have observed that at least 4 flats had large internal fires by 01:52 (Flats 66, 76, 96, 186), as shown in Figure 12.9.

12.3.14 There were 130 occupants remaining in the building at this time; refer to Section 13 for graphs of the number of occupants remaining in the building over time.

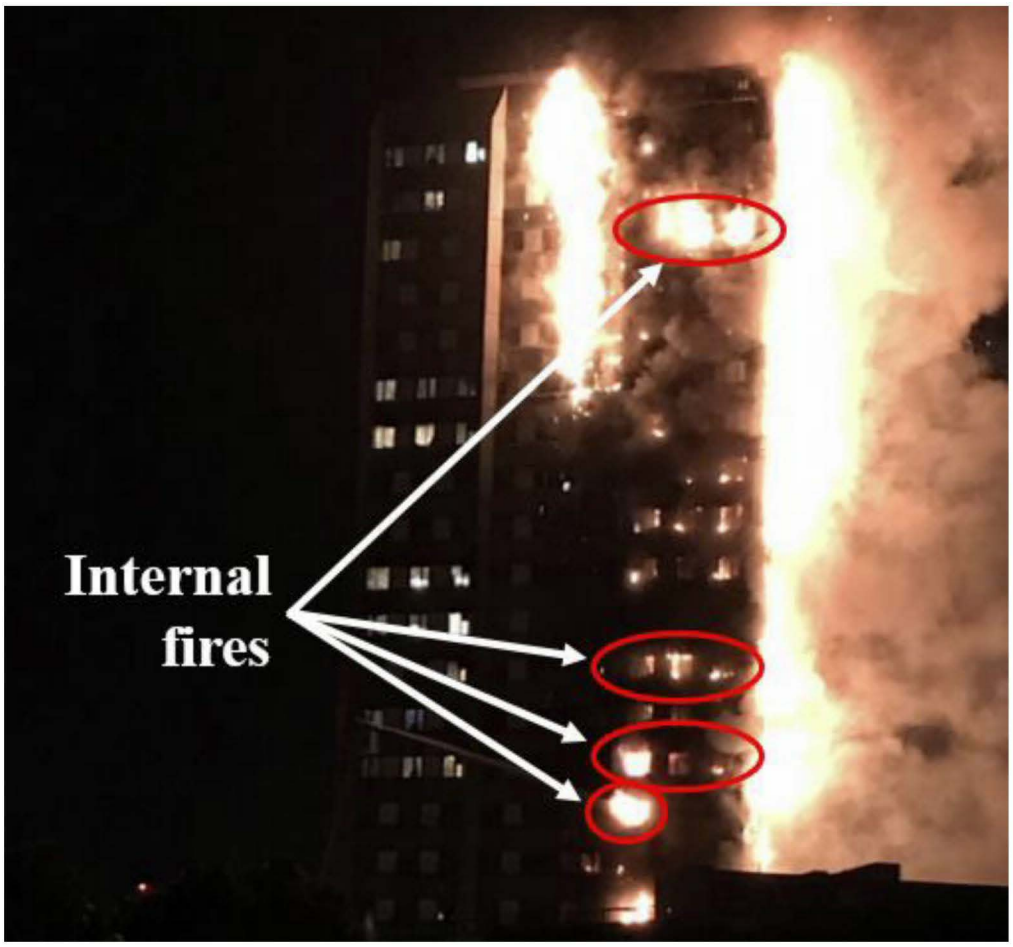


Figure 12.9: Internal fires at 01:52, photograph of East elevation of building (MET00012593)

12.3.15 Based on the screenshot from a video of the external fire spread on the East elevation shown in Figure 12.10, at least 10 flats (Flats 46, 66, 76, 86, 96, 106, 116, 126, 136, 186) had internal fires by 01:57 (exact time of photograph is not known).

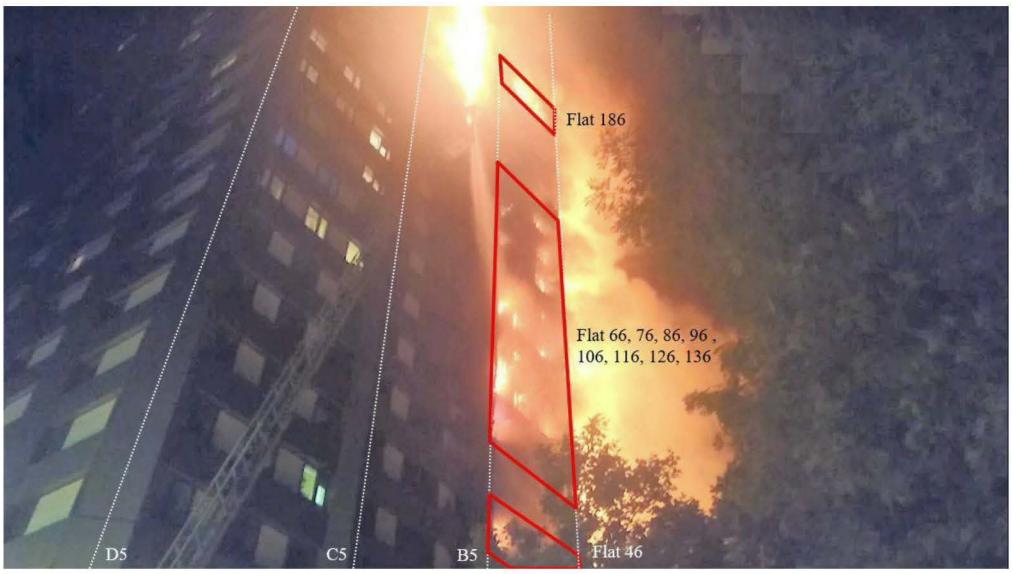


Figure 12.10: Internal fires, photograph of East elevation of building; exact time between 01:43 and 01:57 not known (extract from Video 2 accompanying Luke Bisby's supplemental phase 1 Report)

12.3.16 By 02:23, at least 53 flats had been affected by flame fronts. There were 122 occupants remaining in the building at this time.

12.3.17 Figure 12.11 shows the external fire spread along the East and North elevations of Grenfell Tower between 02:19 and 02:25 (exact time not known). It also shows that at least 10 flats (Flats 86, 96, 116, 126, 136, 146, 156, 186, 196, 206) had internal fires at this time.

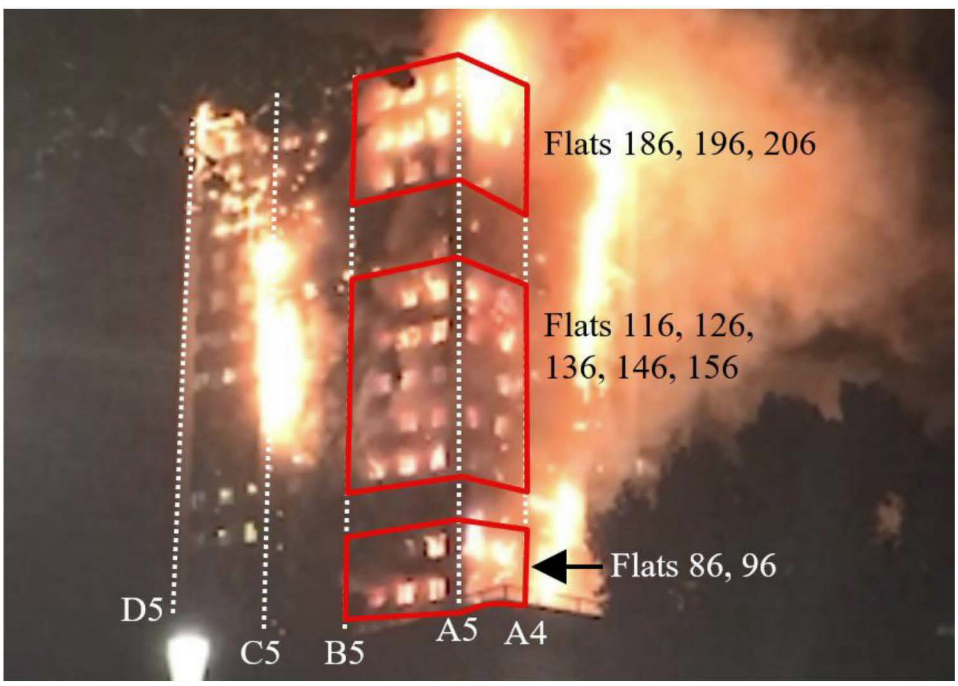


Figure 12.11: Internal fires, photograph of East elevation and North elevation; exact time between 02:19 and 02:25 not known (extract from Video 2 accompanying Luke Bisby's supplemental phase 1 Report)

12.3.18 As the flame front spread across each elevation of the building envelope, an increasing number of internal flat fires were observed in its trail, as shown in Figure 12.12.13 through Figure 12.15 inclusive.

12.3.19 While it is difficult to identify the exact number of internal flat fires precisely, based on quality of these photographs, it is clear that internal fires burned in multiple flats on multiple elevations and compartmentation was breached in several locations. For example, Figure 12.12 shows the fire conditions on the East and North elevations of the building at 03:01. I calculate there are at least 16 internal flashover fires in this photograph. Based on my analysis, 61 flats were affected by the flame fronts by this time (Refer to Table 12.1 and Figure 12.3) and there were 106 occupants remaining in the building.

Figure 12.12: Internal and external fires on East elevation (left) and North elevation (right) at 03:01 on 14 June 2017; 106 number of people still in building at this time[3]

[3] https://www.youtube.com/watch?v=mGfohlJETK0

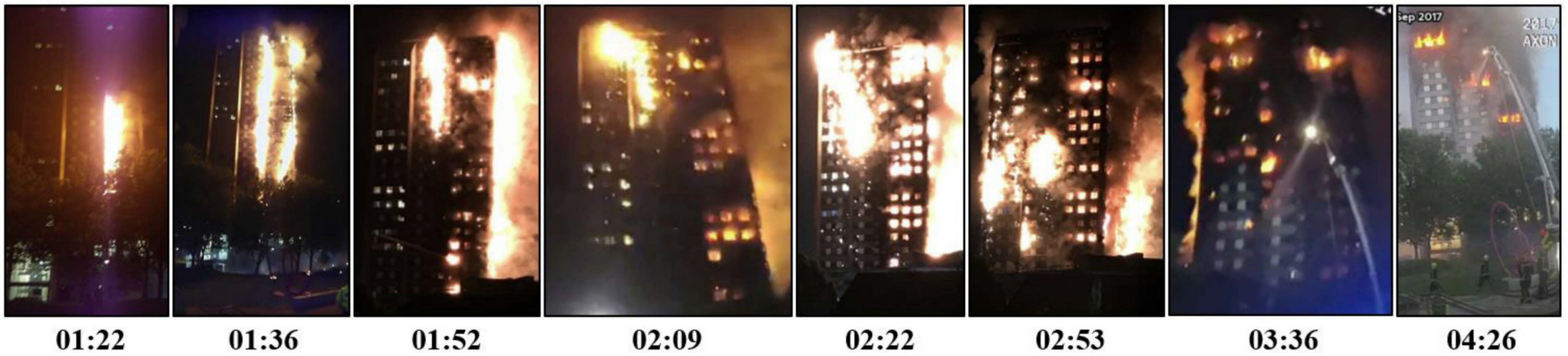


Figure 12.12.13: External flame front on East elevation of building envelope and increasing numbers of internal fires on East building elevation, between 01:22 and 04:26 (MET00012593) [4]

Figure 12.14: External flame front on North elevation (left) and West elevation (right) of building envelope and increasing numbers of internal fires on both building elevations, between 01:36 and 04:20 (MET00012593)

[4] https://www.youtube.com/watch?v=bBCnQvxNaDg

Figure 12.15: External flame front on South elevation (left) and East elevation (right) of building envelope and increasing numbers of internal fires on both building elevations, between 02:33 and 04:39 (MET00012593)

12.3.20 This demonstration allows me to conclude that the principles of the Stay Put evacuation regime can be considered to have started to fail by 01:13, and substantially failed by 01:26, as follows.

12.3.21 The fire had broken out of Flat 16 into the rainscreen cladding system by 01:08 and the fire had spread to Level 5 above by 01:13.

12.3.22 Within a further 8 minutes, the fire had reached the exterior of Flat 86 directly above Flat 16, at Level 11.

12.3.23 The fire continued to spread and had reached Level 23 on the East elevation by 01:26 and 20 flats had now been impacted by the external flame front.

12.3.24 There is evidence of flats affected by smoke as early as 01:20 (MET00012593) and evidence of multiple internal fires by 01:40 (Table 12.2).

12.3.25 These internal fires were also continuing to spread – refer to Figure 12.12.13 for photographs showing a significant number of internal fires on the East elevation of the building between 02:22 and 02:53. And I also provide a series for every elevation in Figure 12.12.13 through Figure 12.15 inclusive.

12.3.26 As I have explained at paragraph 12.1.21 above, the evidence indicates that the Stay Put advice from the LFB was changed by Jo Smith at 02.35 and by AC Roe at 02.47.

12.3.27 With regard to the assumptions on which the statutory guidance for provisions for means of escape is based (ADB 2.3), this demonstration allows me to conclude that:

a) the fire did occur within a flat;

b) the flat *did not* have a high degree of compartmentation due to the failure of the building envelope around that flat, to adequately resist the spread of fire;

c) therefore, *there was not* a low probability of fire spread beyond the flat of origin, and so

d) simultaneous evacuation of the building *became highly likely to be necessary* as a result.

12.3.28 The statutory design guidance advises simultaneous evacuation is "*unlikely to be necessary*" **only** where there is a high degree of compartmentation and so a low probability of fire spread beyond the flat of origin. The spread of fire and smoke through multiple compartments and into the lobbies meant this high degree of compartmentation was not available and fire spread beyond the flat of origin had occurred.

12.3.29 Therefore, as the statutory design guidance advises - simultaneous evacuation of the flats became necessary. This is in the context of the building design

condition, and the active and passive fire protection measures provided. Please refer to Section 3 of my Expert Report.

12.3.30 This represents the total failure of the design principles of the Stay Put evacuation regime.

12.3.31 I intend to update the quantities of internal fires, when the oral evidence currently underway from the BSRs, ends in November 2018.

12.4 The significance of the building envelope fire

12.4.1 Because the single safety condition designed for i.e. the Stay Put evacuation regime, was rendered ineffective, this created serious consequences for the resulting need for an evacuation.

12.4.2 However, the spreading fire also created substantial consequences regarding firefighting access and facilities, and caused the failure of the Defend in Place firefighting that is an essential component of the Stay Put design condition.

12.4.3 Please refer to Figure 12.16 for a diagram demonstrating considerations required due to the building envelope form (materials and their arrangement) on Grenfell Tower.

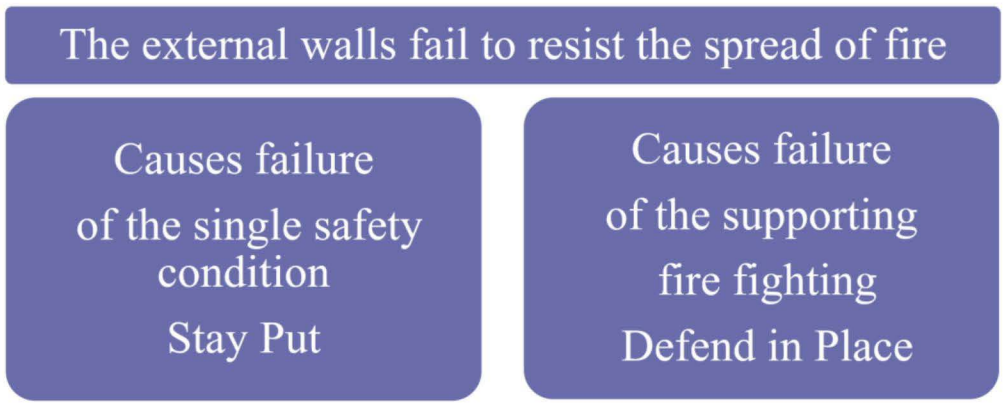


Figure 12.16: Diagram demonstrating considerations required due to the building envelope form on Grenfell Tower

12.4.4 Please refer to Figure 12.17 and Figure 12.18 for diagrams demonstrating the investigations required into the failures of the Stay Put regime and the Defend in Place regime at Grenfell Tower.

Figure 12.17: Diagram demonstrating the investigations required due to the failure of the Stay Put regime

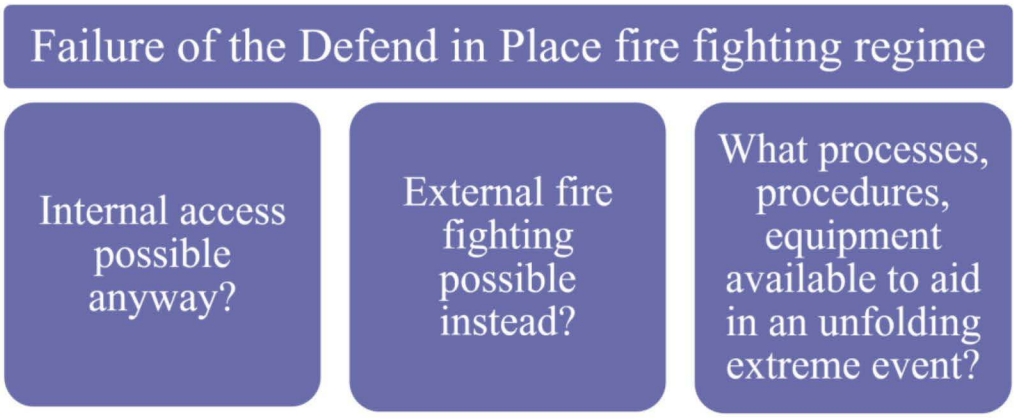


Figure 12.18: Diagram demonstrating the investigations required due to the failure of the Defend in Place firefighting regime

12.4.5 It therefore becomes necessary for me to explore what facilities were made in and around the building, and actually available to LFB at Grenfell, to deal with the unfolding events, including the failure of the Defend in Place firefighting that supports the Stay Put safety condition:

a) What **internal** firefighting was required for the fire scenario created and what provisions were available at Grenfell Tower?

b) What **external** firefighting was possible for the external fire scenario created at Grenfell Tower and what provisions were available at Grenfell Tower?

c) What preparations had been made, and what was possible, to enable the use of standard processes, procedures and equipment during an unfolding extreme event?

d) What communication from LFB was needed regarding the failure of the Stay Put condition for the residents and how could this be done?

12.4.6 Please refer to Figure 12.19 for a diagram demonstrating the investigations required into the firefighting options at Grenfell Tower, because of the presence of the external wall which failed to resist the spread of fire.

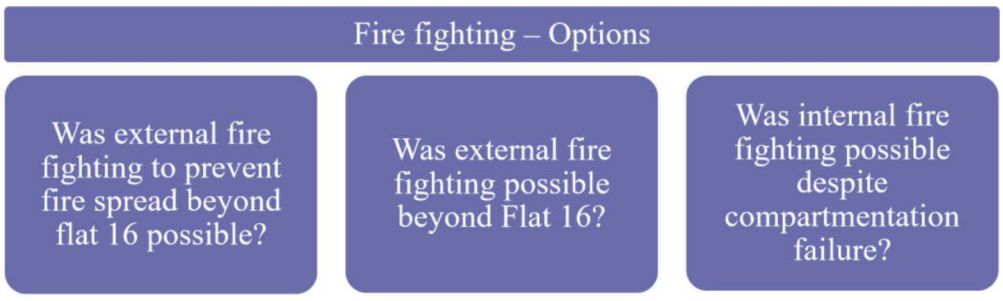


Figure 12.19: Diagram demonstrating the investigations required into the fire fighting options at Grenfell Tower

12.4.7 Please refer to Figure 12.20 for a diagram of the investigations required into the issues with firefighting options at Grenfell Tower because of the presence of the external wall which failed to resist the spread of fire.

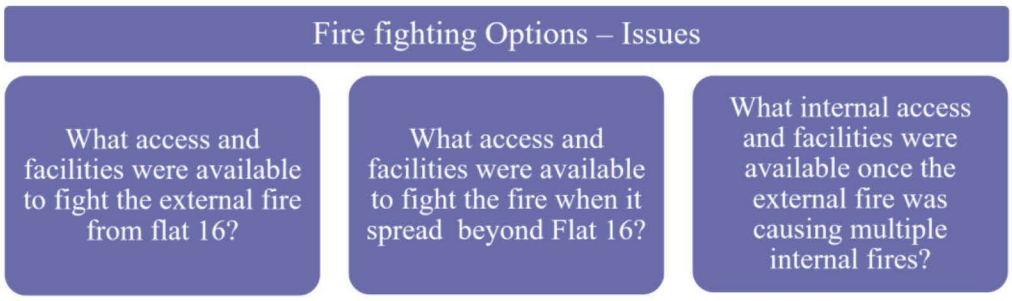


Figure 12.20: Diagram demonstrating the investigations required into the issues with firefighting options at Grenfell Tower

12.4.8 Regarding evacuation, if the single safety condition designed for at Grenfell Tower, the Stay Put evacuation regime, was no longer viable, what options were available to the residents instead? I therefore need to explore, from a building perspective:

a) what provisions were available for communicating when and how to evacuate, to all the residents;

b) what provisions were available at Grenfell Tower, during this external and internal fire event, for self-evacuation;

c) what provisions were available to facilitate rescue from LFB.

12.4.9 Please refer to Figure 12.21 for a diagram of the investigations required into evacuation options for residents at Grenfell Tower because of the presence of the external wall which failed to resist the spread of fire.

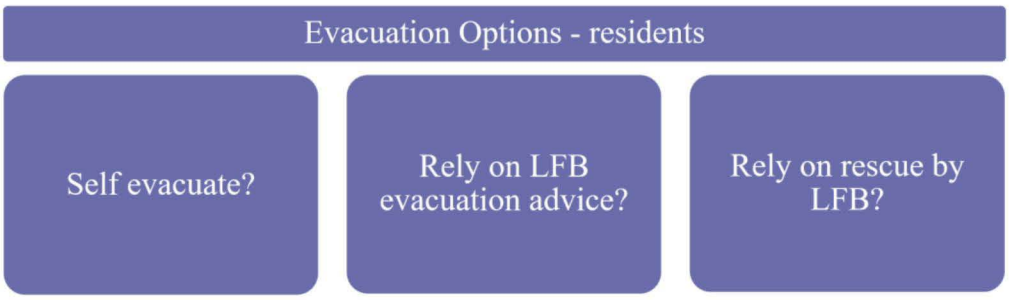


Figure 12.21: Diagram demonstrating the investigations required of the provisions for evacuation at Grenfell Tower

12.4.10 Please refer to Figure 12.22 for a diagram of the investigations required into the fire fighter issues relating to evacuation options for residents at Grenfell Tower because of the presence of the external wall which failed to resist the spread of fire.

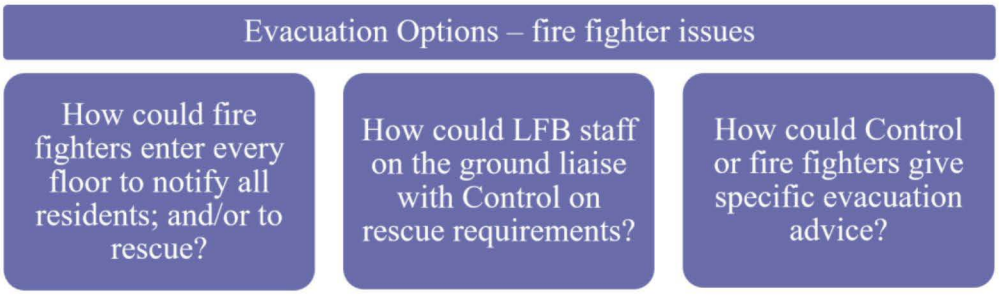


Figure 12.22: Diagram demonstrating the investigations required of fire fighter issues relating to evacuation options for residents at Grenfell Tower

12.4.11 In order to explore these issues, I have carried out a range of investigations. I analyse the potential for evacuation and the potential for firefighting in the next sections of my report: Section 13 – 19 inclusive.

12.4.12 In Section 13, I present my derivation of critical times during the fire event. This forms the basis for my analysis of the performance of the protected stair and lobbies (in Section 14), during this multi storey external fire. I have to consider the timing of the evacuation of the residents, and their dependence on the decision making and actions of LFB.

12.4.13 I have to consider what was required of LFB as a result of the failures in the design and construction of the rainscreen cladding system during the fire. I address this in Section 17.

12.4.14 I provide my analysis of the methods available for communicating with the residents of Grenfell Tower once the Stay Put policy was changed, in Section 18.

12.4.15 I will consider what role, if any, the active and passive systems in Grenfell Tower played in failing to control the spread of fire, or the role they played in the speed at which the fire spread (Section 19).

12.4.16 Ultimately, I have to consider what was required of the residents to protect themselves, as a result of the failures in the design and construction of the rainscreen cladding system during the fire.

12.4.17 I have to consider what was required of the fire brigade and what they have available to them in the early, middle and late stages of the fire. Specifically, what they could ever have done to slow down or prevent the fire and smoke spread; and what they could ever have done about giving evacuation advice, and exercising rescue.

12.4.18 I will also consider whether the life safety of the residents, became too dependent on the decision-making and actions of the fire service, on the night of the fire, because of the failure of the building envelope, and the resulting failures of active and passive systems in Grenfell Tower.

12.4.19 I address this in Section 19 and 20.

12.4.20 Additionally, in Phase 2 I will consider if once the fire started and spread in to the external wall system:

(a) Is it the case that the only layer of safety remaining for building occupants was the fire brigade actions (regarding evacuation, rescue and fire fighting);

(b) if a building system causes a failure at a scale that only a single layer of safety remains, is this a breach of statutory duties regarding life safety; and

(c) if it is reasonable to require a fire service to mitigate the consequences of total building failure.