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 14

The performance of the protected stair and lobbies

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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14 The performance of the protected stair and lobbies

14.1 Purpose of this Section 14

14.1.1 In this section I present my analysis of the performance of the single escape stair and its protected lobbies, based on two sources of evidence.

14.1.2 The first was the evidence I found from my own post-fire site inspections in Grenfell Tower. I carried out these inspections at the start of my work for the Public Inquiry, with a team of fire and systems experts from Arup acting under my supervision.

14.1.3 The second source of evidence is from eyewitness sources. This consists of the London Fire Brigade witness statements; and resident witness statements provided to me. It also includes transcripts of oral evidence of firefighters during the Public Inquiry hearings. I have provided a reference where I refer to the contents of a witness statement. Transcripts are referenced by name and date of hearing.

14.1.4 I have been provided with two types of statement from firefighters: formal witness statements and contemporaneous notes prepared after the fire. By way of shorthand in this section (and elsewhere in my report), I refer to both as firefighter witness statements.

14.1.5 If further London Fire Brigade witness statements or oral evidence transcripts become available in due course and, to the extent that it becomes necessary to do so, I will revise and update my work at a later stage.

14.1.6 I have been provided with witness statements from a number of the residents of Grenfell Tower. I expect further evidence from residents to become available to me as a result of residents providing oral evidence to the Public Inquiry Hearings.

14.1.7 I will need to update my work and make final changes, to the timings and conditions for escape and resident experience of rescue, once this oral evidence becomes available to me.

14.1.8 I am particularly interested in:

(a). the time between 00:55 and 01:40 and the smoke conditions in the stairs during early firefighting;

(b) the hour between 01:40 and 02:40am: the time when conditions in the lobbies appear to have greatly deteriorated, until the time the Stay Put guidance was changed; and

(c) the difference in opinion on the conditions in the stairs when I compare the firefighter progress up the building and the self-evacuation of residents as late as 04:20. The evidence of a hot zone at the central floors is important here.

14.1.9 A forensic timeline of firefighter activity is being prepared by the expert to the Inquiry Steve McGuirk. I will need this data to understand the refined timings around stair doors being open in the early stages of the fire.

14.1.10 An emerging piece of witness evidence regarding smoke leaking out of the smoke extract dampers in the lobbies requires careful consideration and analysis. I will complete that work after the resident evidence is completed in full.

14.1.11 I also refer to the Metropolitan Police data provided to me regarding the time each resident left the Grenfell Tower; as well as the location of the deceased residents of the Grenfell Tower, relative to their own flat. I have relied on this data for the sole purpose of understanding movement within the single escape stair and lobbies only.

14.1.12 I was not present in the Grenfell Tower during the fire, and so I provide what is a technical assessment as I have been able to derive it. However, I want to take this opportunity, before I present my technical assessment, to emphasise how harrowing the available descriptions of conditions in the stairs and the lobbies are.

14.1.13 It is my opinion that the conditions of the stairs and lobbies would have created intense fear amongst the residents which is likely to have affected the ability of many of them to leave their flat and descend the stair. As the fire progressed, and conditions worsened, it was even more difficult to overcome this fear, even when they were eventually instructed to do so.

14.1.14 The evidence from the residents has emphasised this stark dilemma for them all too clearly.

14.1.15 The residents were left in conditions that appeared life threatening to them. So much so that even with a flame front entering their home or neighbour's home, entering the staircase was believed to be a fatal option. In some cases, this belief appears to have seriously impacted their decision making process with respect to self-evacuation. It is my opinion they required very specific advice tailored to overcome their fear of the lobby conditions, and to be informed, for example, that there was a concerted effort to meet and rescue people in the stairs.

14.1.16 It is my opinion that the conditions created difficult, and at times life threatening conditions, for London Fire Brigade (LFB). The conditions greatly restricted their ability to implement their standard processes and procedures, regarding firefighting once the fire spread beyond Flat 16.

14.1.17 The conditions created a scale of rescue that overwhelmed the LFB's standard rescue processes. As I have presented in Section 12 of my report, by 01:40 there were 20 flats affected by flame fronts. By 02:40 this had increased to 56.

14.1.18 I have explained in Section 3 how active and passive fire protection measures are required to enable the early suppression of a fire - the "Defend in Place"

firefighting tactic – and how this is a critical component for any Stay Put strategy.

14.1.19 The scale of fire spread externally created a speed and scale of internal flashover fires that became unmanageable from an active firefighting perspective. Those fires posed a serious risk to the lives of all occupants of the Grenfell Tower – residents and firefighters.

14.1.20 Rescue remained the focus throughout the night. However, another consequence of the conditions of the stair and its lobbies was how it impacted on the LFB's ability to exercise their formal rescue processes; and how it impacted their ability to exercise informal rescue (by which I mean in breach of their own standard processes). There is evidence of some informal rescue attempts throughout the fire. The detail of these firefighting and firefighter rescue matters are the subject of expert evidence by others at a later stage in this Public Inquiry.

14.1.21 This is relevant to my work because the active and passive fire protection measures are required to provide a safe working environment for the fire and rescue services. The consequences of the failure of protection measures impacts two groupings, the residents and the firefighters.

14.1.22 Therefore, it is necessary for me to piece together the evidence I have available, from a variety of sources, to provide a complete picture of conditions in the stairs and lobbies.

14.1.23 This evidence was not available to decision makers or residents on the night. Smoke spread occurred early in the fire, and for some residents posed an early stage threat. For other residents this was not initially the case.

14.1.24 Over time, for very many residents, getting to the stair meant passing through what appeared to be life threatening conditions in the lobby, and onwards into what appeared to be entirely unknown conditions on the stair.

14.1.25 For some residents they had already experienced conditions in the stairs and considered them to be life threatening and so turned back.

14.1.26 For other residents, they had entered the stairs or approached the stairs, and heard instructions not to go down the stairs at all, and again had turned back.

14.1.27 The firefighters had breathing apparatus. The residents had nothing to aid them.

14.1.28 There were other signals of danger to residents, and to firefighters. This included large quantities of thick smoke impacting sight and breathing immediately outside flat entrance doors, intense heat outside flat entrance doors, heat and smoke within the stair itself; rapidly advancing fire and smoke entering flats from the outside, and ultimately horrific and rapidly increasing numbers of fires for the residents to attempt to escape away from, and for the firefighters to mitigate.

14.1.29 In total there were 153 Fire Survival Guidance (FSG) calls (including duplicates) made between 01:15 and 04:45, each one would then require an active rescue plan. Please refer to Section 14.4.172 for my definition of FSGs and my analysis of the call data.

14.1.30 An important topic also for investigation is residents who could not evacuate without assistance (residents who could not walk down stairs). I will incorporate the final numbers of persons requiring assistance when that evidence is finalised. There was no active facility available to them for self-evacuation (this is dealt with in detail in Section 15, 16 and 18 of my report).

14.1.31 In this Section 14, I will therefore analyse how the stairs and lobbies appear to have performed during the fire. I will then explain the results of my analysis of the fire safety provisions for Grenfell Tower in Section 15 - 18, and what evidence I have found regarding their adequacy at this stage.

14.1.32 I will use my findings to make my preliminary explanation in Section 19 as to how the stairs and the lobbies failed for the residents, and failed for the firefighters.

14.1.33 The single stair and lobbies, and the fire safety provisions therein, were not ever designed to create a safe escape route or safe working environment in a whole building fire. The design approach for high rise residential buildings is based on inhibiting that from occurring.

14.1.34 However, because of the cladding fire, a whole building fire occurred, and so the single escape stairs and its lobbies became the single most important life safety feature. As I explain further in later sections, I have considerable concern as to the standards of fire safety provision in the lobbies and the stair, whilst acknowledging the extreme and primary hazard the cladding presented.

14.1.35 This Section 14 of my report should be read alongside the Critical Times analysis I have presented in Section 13. It may help the reader to refer back to those times and external conditions when reading this part of my report, which focuses now on conditions within Grenfell Tower.

14.1.36 **Important caveats to the analysis in this section**

14.1.37 It is important to emphasise at the outset of this Section 14 that, when using the firefighter and survivor evidence as sources of evidence to assess the conditions of the stair and protected lobbies during the night, I have had to make certain assumptions about the timings, in an attempt to bring some structure to my analysis.

14.1.38 I am very aware that both firefighters and survivors are likely to have difficulties in recalling what occurred on the night with any precision, given the stressful and traumatic events which occurred and the difficulties they may have encountered since. I am also aware that they have given oral evidence some time after the events occurred, which may also affect its reliability.

14.1.39 I am aware that some of the available timing information is limited and that there may be inconsistencies which are likely to be difficult for me to resolve on the basis of the available evidence. I am also aware that some of the evidence only assists as to a time frame within which some events occurred (e.g. by reference to the firefighter telemetry data) and that any greater precision or estimation may be prone to error.

14.1.40 As I have already made clear above, at the time of writing this report, the survivor oral evidence is still ongoing and I will want to update this analysis at Phase 2 once I have had a proper opportunity to consider all of the details which that evidence is producing (and which I consider to be very important to my overall analysis).

14.1.41 I do not wish the text in this Chapter to be read as indicating that the evidential picture is more certain than, in fact, it is. I have tried to focus on the most reliable sources of information, but inevitably it has been necessary to try to provide some approximate timings, in order that I can make an assessment as to how the lobbies and stairs performed, from a design perspective.

14.1.42 If I am to make recommendations in Phase 2 as to potential changes to design guidance, it is important that I try and make an assessment of how the lobbies and stairs performed, by reference to the evidence, so that I can consider whether there are design changes which need to be considered.

14.2 Purpose of protected stairs and lobbies in residential buildings

14.2.1 Stairs and lobbies as means of escape

14.2.2 In a residential building using a Stay Put evacuation strategy, the stairs are intended to be a protected space, or a *"place of relative safety"* (as described by the statutory guidance Approved Document B (ADB) 2013, Section B1.v(b). Section B1.ix which states:

"Protected stairways are designed to provide virtually 'fire sterile' areas which lead to places of safety outside the building. Once inside a protected stairway, a person can be considered to be safe from immediate danger from flame and smoke. They can then proceed to a place of safety at their own pace. To enable this to be done, flames, smoke and gases must be excluded from these escape routes, as far as is reasonably possible, by fire-resisting structures or by an appropriate smoke control system, or by a combination of both these methods."

14.2.3 The 1971 CP3 British Standard Code of Practice CP3: Chapter IV Part 1 Flats and Maisonettes (in blocks over two storeys), and referred to as CP3 here on in, which was relevant design guidance at the time of construction of Grenfell Tower, provides a helpful explanation of the 3 stages of risk forming the basis of the Stay Put strategy and the active and passive systems provided to support it in high rise blocks of flats. (See Section 3).

14.2.4 These are:

a) Stage 1 – the risk to the occupants of the dwelling in which the fire originates;

b) Stage 2 – the risk to the occupants of the dwellings on the same floor of the flat of fire origin, if smoke or fire should penetrate the common corridor/lobby outside that flat;

c) Stage 3 – the risk to the occupants of dwellings on floors above the floor of outbreak, if smoke or fire should penetrate the stair enclosure or the escape route from the foot of the stair to open air.

14.2.5 In CP3, protection to the stair is provided by physical enclosure with fire resisting construction and the use of ventilated lobby access to the stair. The lobby is also enclosed with fire resisting construction. As described in the Stage 3 risk above, these elements of protection are explicitly provided to prevent smoke and fire from compromising the safe use of the stair by occupants of the building on any floor above the fire floor: "*in the event that the fire is not extinguished early*", (Section 2.4.2.2(2) of CP3 1971).

14.2.6 The protection provided to stairs in residential buildings is therefore intended to:

a) Physically prevent the penetration of smoke and fire into the stair enclosure by provision of fire resisting construction including the stair door;

b) Prevent smoke from entering the stair by provision of fire resisting lobbies (including the flat entrance door, and protected risers) combined with a lobby smoke control system; and so

c) Prevent the spread of fire and smoke blocking use of the protected stair for residents above the fire floor.

14.2.7 The ability of residents to escape from Grenfell Tower was entirely dependent upon the performance of the sole means of escape route provided to them within the building.

14.2.8 The fire at Grenfell Tower was a multi storey external fire that caused a multi storey internal fire.

14.2.9 **Function of stairs and lobbies for firefighting**

14.2.10 All aspects of firefighting will be the subject of expert evidence at a later stage in this Public Inquiry. I am referring to published guidance documents only, to explain the typical role of a firefighting stair, for my own work which considers building design and protection measures. The design and protection measures are provided to enable safe fire fighting, hence the intersection with my work.

14.2.11 The tactics used in the UK for fighting fires in high rise buildings are as described in Fire and Rescue authority guidance (*Fire and rescue Authorities*

Operational Guidance, GRA 3.2: Fighting fires – in high rise buildings, 2014), which I have summarised below. Please refer to Appendix H for more details of these tactics.

14.2.12 Two crews will be dispatched towards the fire floor using the firefighting lift. The crews will take the lift to the firefighting lobby two floors below the fire floor, creating a protected Bridgehead.

14.2.13 A Bridgehead is defined in *Fire and Rescue Manual: Volume 2 - Fire Service operations - Incident Command, 3rd edition 2008* (Incident command manual) as:

"A central and advanced control point where it is necessary for BA (breathing apparatus) *to be started up at a distance from the original point of entry to a risk area, whilst remaining in a safe air environment"*

14.2.14 GRA 3.2: 2014 also states that:

"All personnel committed beyond the bridgehead must be wearing full personal protective equipment and respiratory protective equipment. The only exception to this would be when the incident Commander has deemed it safe for fire and rescue personnel to work above the bridgehead without respiratory protective equipment."

14.2.15 Any ingress of smoke into a firefighting lobby or common residential lobby prevents it from being used as a Bridgehead as it would no longer be a safe air environment.

14.2.16 A fire-fighting lobby is contained within a fire-fighting shaft. It is enclosed by fire resisting construction and fire resisting self-closing doors (fire doors). It separates a firefighting stair from the rest of the storey it serves. ADB 2013 Section 17 makes provisions for the design of a fire-fighting lobby.

14.2.17 A common lobby is a space connecting one or more residential units to an escape stair and/or firefighting stair. ADB 2013 Section 2 and Section 17 make provision for the design of a common lobby.

14.2.18 Once the Bridgehead has been secured, the first crew will then use the stairs to walk up to the floor below the fire floor and set up for active firefighting in the firefighting lobby. The first crew, with a charged hose, will walk up the stairs to the fire floor. Therefore, it is assumed that the first crew is able to approach the rising main outlet in a protected lobby below the fire, i.e. a relatively safe place.

14.2.19 The second crew, acting as backup, will follow the first crew onto the fire floor, and connect to the riser outlet in the lobby on that floor. The second crew are tasked with protecting the firefighting lobby on the fire floor and will always have a sufficient hose available to reach the primary crew if they require assistance or become cut off from the firefighting lobby. As the first crew advances onto the fire floor with a charged hose, they will be able to act to create tenable conditions in the firefighting lobby on the fire floor (if

required) for the second team to approach the fire main outlet on the fire floor.

14.2.20 These tactics have the following stated benefits in fighting fires in high rise buildings:

a) Minimises use of breathing apparatus air supply to access the fire sector; and

b) Reduces difficulty in manoeuvring charged hoses around corners in stairs by minimising the number of stair flights being traversed.

14.2.21 As described below, the design of firefighting stairs in high rise buildings therefore requires the provision of a smoke control system, functioning fire resisting enclosures around the lobby and the stairs, including functioning fire doors to flats, and the stair; and any risers protected where they pass through the lobby. This system is intended to prevent smoke entering the stair, when two stair fire doors are open – on the fire floor and the floor below.

14.2.22 The two stair doors are open to enable access for hoses. In accordance with the relevant British Standard (BS EN 12101-6), the doors that are designed to be open for firefighting, are:

i. The stair door to the fire floor,

ii. The stair door to the floor below the fire floor where the first team connects to the rising main outlet, and

iii. The door direct to outside the building at the bottom of the stairs.

14.2.23 Please refer to Appendix J for further details of the statutory guidance for smoke control systems.

14.2.24 All other stair doors are assumed to be closed and functioning as a fire door. All flat fire doors on the fire door are assumed to be closed except the flat where fire fighting is taking place.

14.2.25 The Incident Command manual also provides guidance on how tall buildings should be broken into operational sectors, as shown in Figure 14.1.

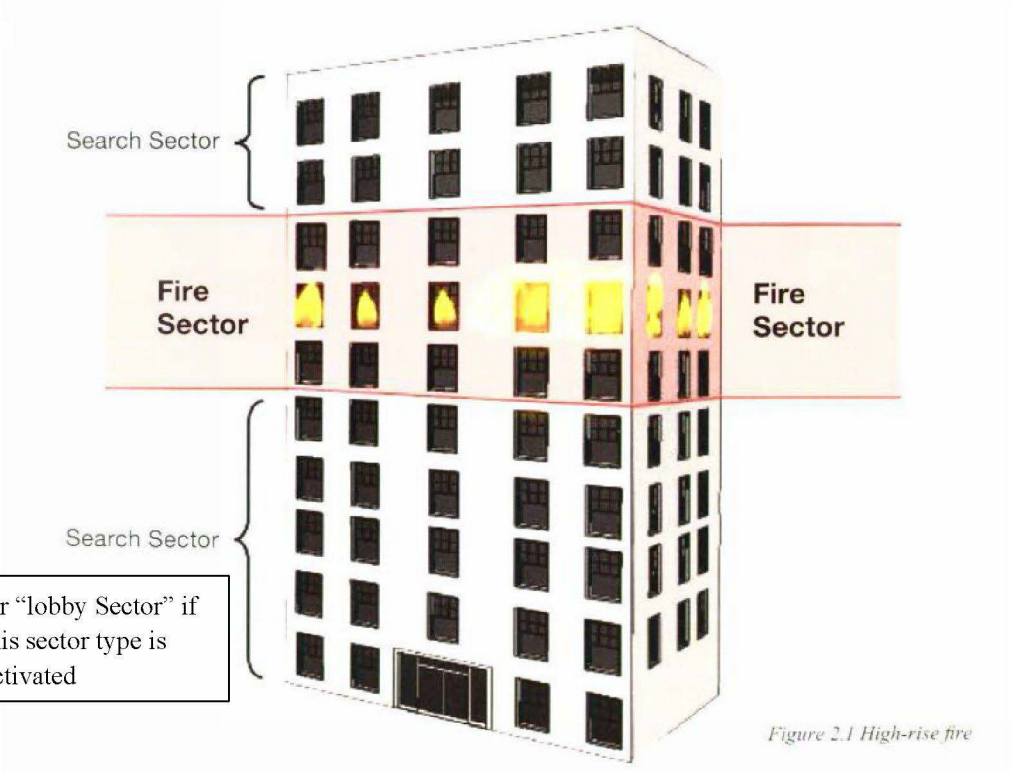


Figure 14.1: Excerpt from Incident Command manual (p27)

14.2.26 This guide identifies the 3 following sector types on Page 27:

"Fire Sector – this is an operational sector and would be the main area of firefighting and rescue operations, consisting of the floor/s directly involved in fire, plus one level above and one level below. If crews involved in this exceed acceptable spans of control, consideration should be given to activating a Search Sector

Search Sector – this is an operational sector and would be the area of operations in a high rise, above the 'fire sector' where search and rescue, venting and other operations are taking place. In a basement scenario the Search Sector could extend from fresh air to the lowest level. If the distance from the ground floor lobby to the bridgehead is more than two or three floors and spans of control require it, consideration should be given to activating a Lobby Sector.

Lobby Sector – this is a support sector and would cover the area of operations from the ground floor lobby to the bridgehead, which is normally two floors below the fire floor, The Lobby Sector Commander will act as co-ordinator of all the logistics needs of the fire and search sector Commanders, who will, on most occasions, need to be located at the bridgehead directing operations via radio and liaising with the BAECO (breathing apparatus entry control officers). The Lobby Sector Commander would also co-ordinate all operations beneath the bridgehead level, including salvage and ventilation, liaising with fellow Sector commanders in the usual way."

14.2.27 The ability of firefighters to undertake this approach is dependent upon the performance of the access facilities provided within the building.

14.2.28 Fire and Rescue Authorities must also have effective arrangements in place to handle fire survival guidance calls from residents and others when they believe they are unable to leave the building due to disability, poor mobility, illness or the effects of fire and smoke. The Bridgehead location and lobby sector location forms an important role for this activity, as it is in these locations all such advice and resulting actions are co-ordinated.

14.2.29 According to GRA 3.2 2014, fire survival guidance call arrangements made by the fire brigade, should include:

a) "details of how calls will be passed to and recorded at the incident

b) their impact on resources and mobilising

c) a re-evaluation process to ensure the balance of risk to the public is reviewed if circumstances change (which may result in a change to the advice previously given)

d) how information will be exchanged between callers, Fire Control and commanders at the incident."

14.2.30 For all of these fire brigade actions and activities, fully functioning compartmentation in the building is required.

14.3 The protected stair & lobbies in Grenfell Tower

14.3.1 At the time of the fire in June 2017, I understand that Levels 04 -23 of Grenfell Tower were provided with the following fire safety provisions for the stair and the lobbies:

a) A single escape stair serving all levels above the ground floor.

b) Access to the single escape stair from each flat by a protected common lobby.

c) Flat entrance fire doors and compartment walls separating each flat from the lobby.

d) Protected shafts containing services passing through the lobby

e) Stair fire doors separating the lobby from the stair.

f) A smoke ventilation system in the lobby intended to provide protection to the stair.

g) Emergency lighting within the lobby and stair.

h) Two fire lifts, both provided with over-ride controls for use by the firefighters.

i) A vertical dry rising fire main with an outlet at every level.

j) Note, at Ground to Level 3, by exception–

i. Non-residential lobbies were provided with 0.4m^2 vents for smoke control purposes.

ii. Separate permanent vents were also provided to the new stair enclosure between Ground and Level 2 for smoke control purposes.

14.3.2 I have illustrated the location of each of these features of the protected stair and lobby in Grenfell Tower in Figure 14.2 to Figure 14.6.

14.3.3 I provide the findings from my review of all these provisions in Sections 15 – 18 inclusive in this report. I rely on my own post-fire site evidence for the remainder of this Section 14.

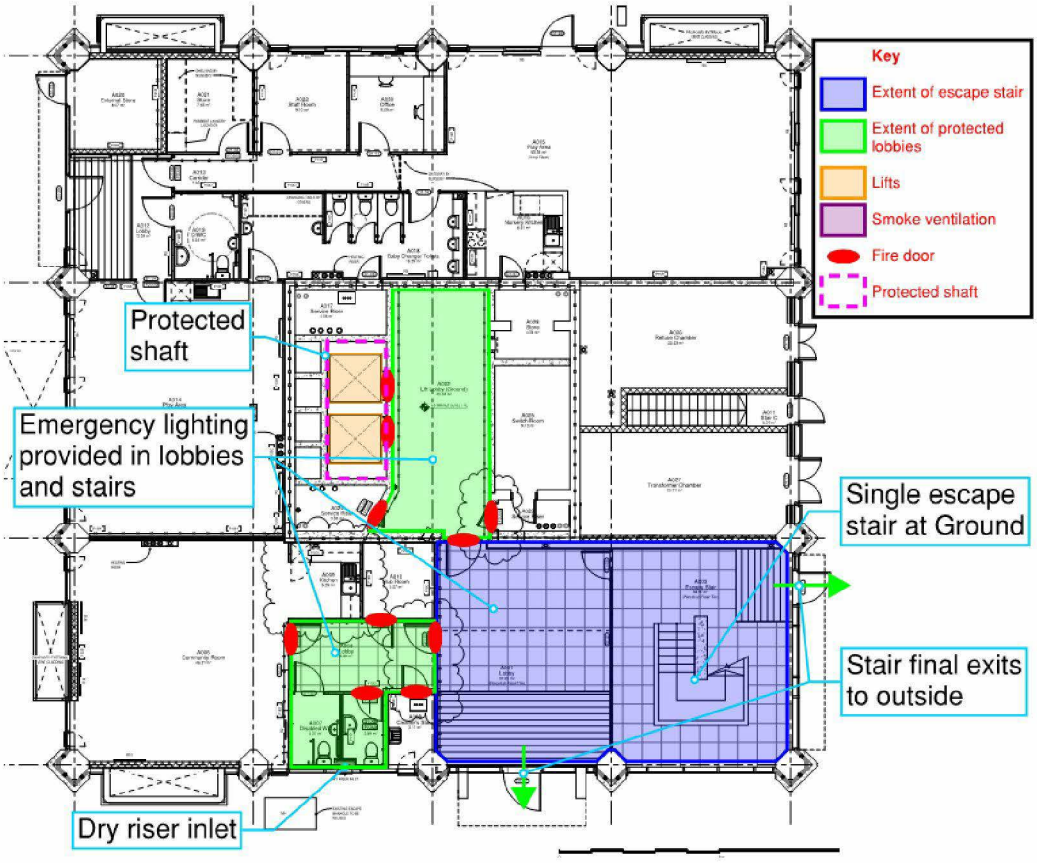


Figure 14.2: Stair and lobby location and features at Ground Floor (SEA00003232)

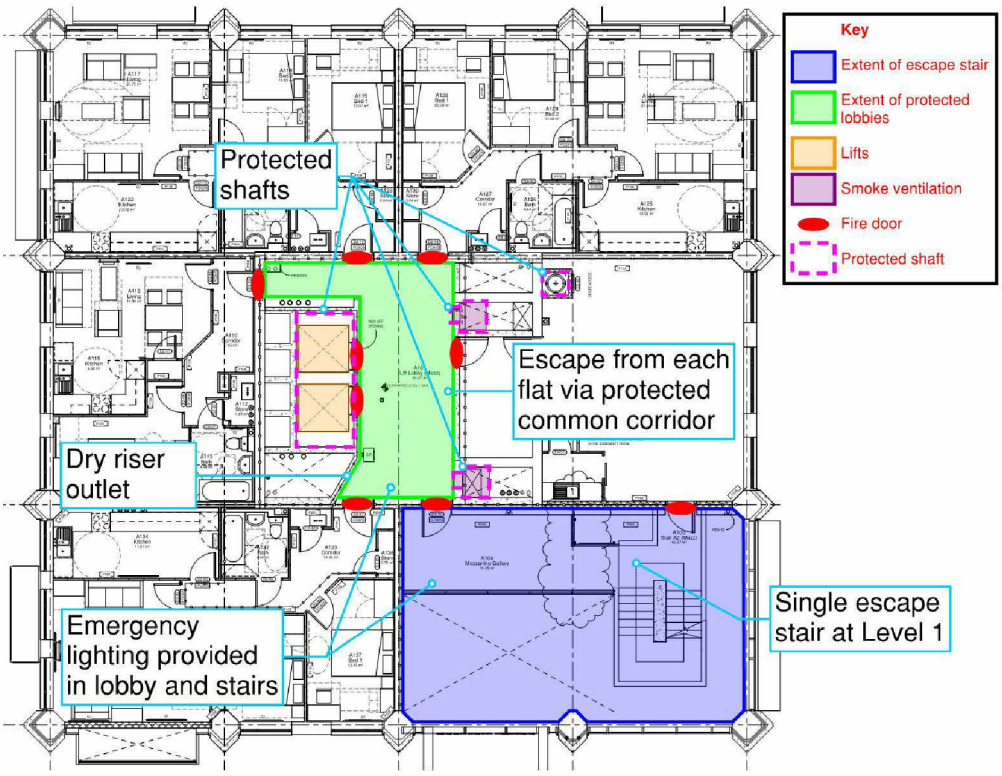


Figure 14.3: Stair and lobby location and features at Level 1 (SEA00003231)

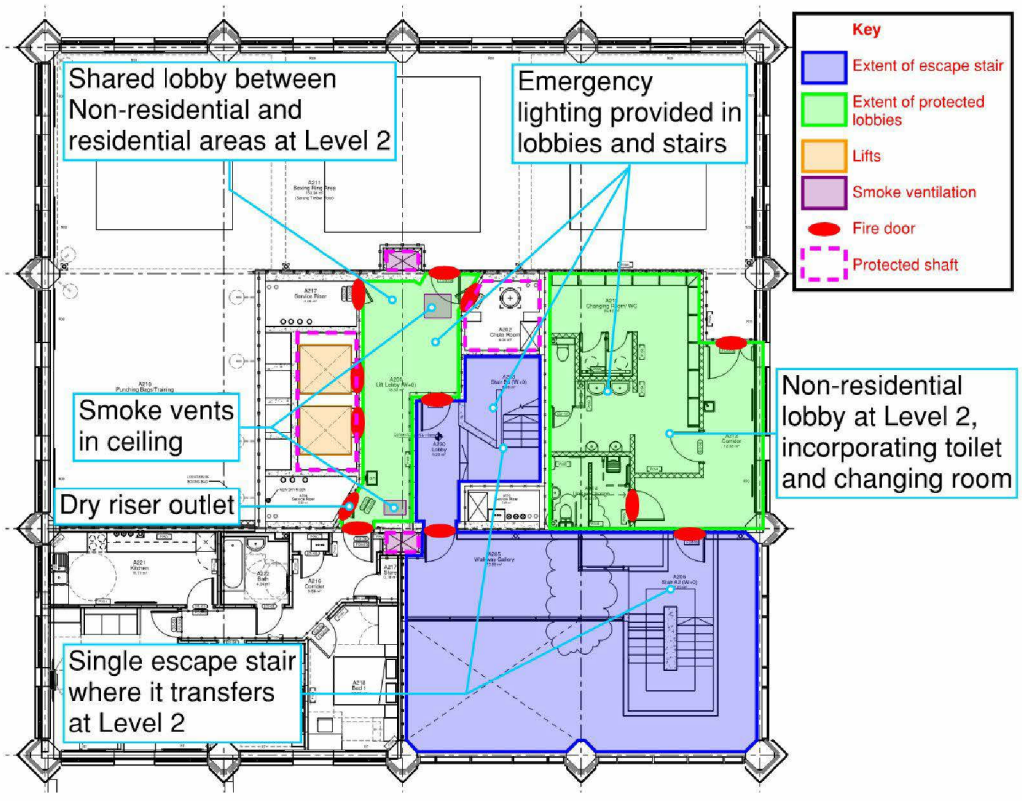


Figure 14.4: Stair and lobby location and features at Level 2 (SEA00003149)

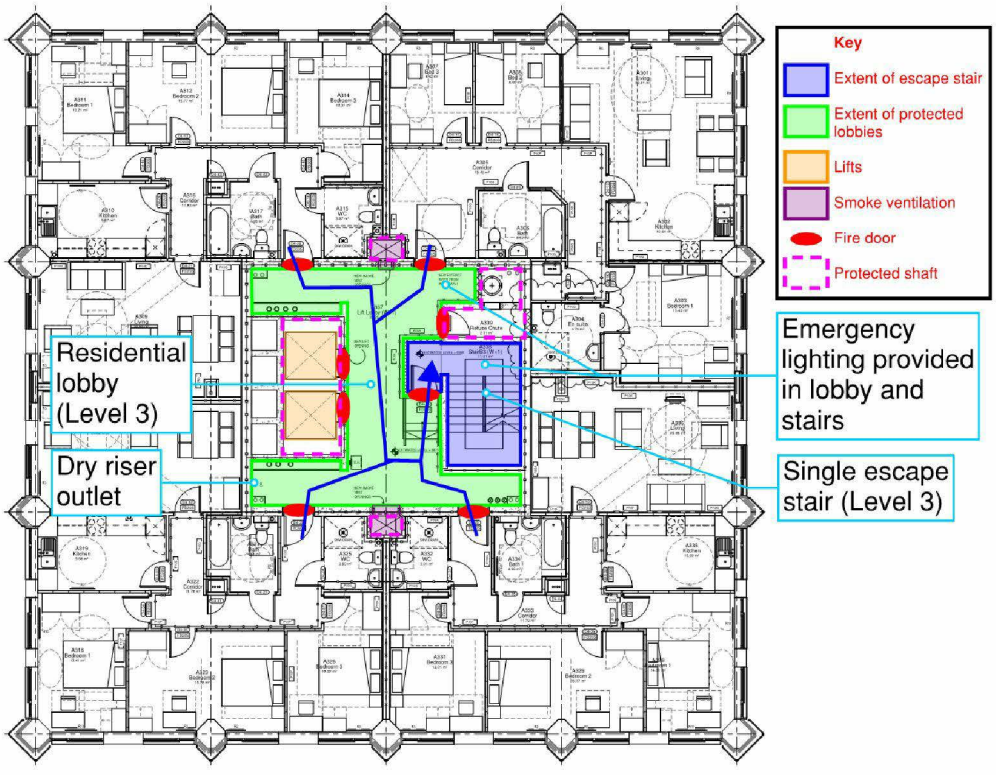


Figure 14.5: Stair and lobby location and features at Level 3 (SEA00003229)

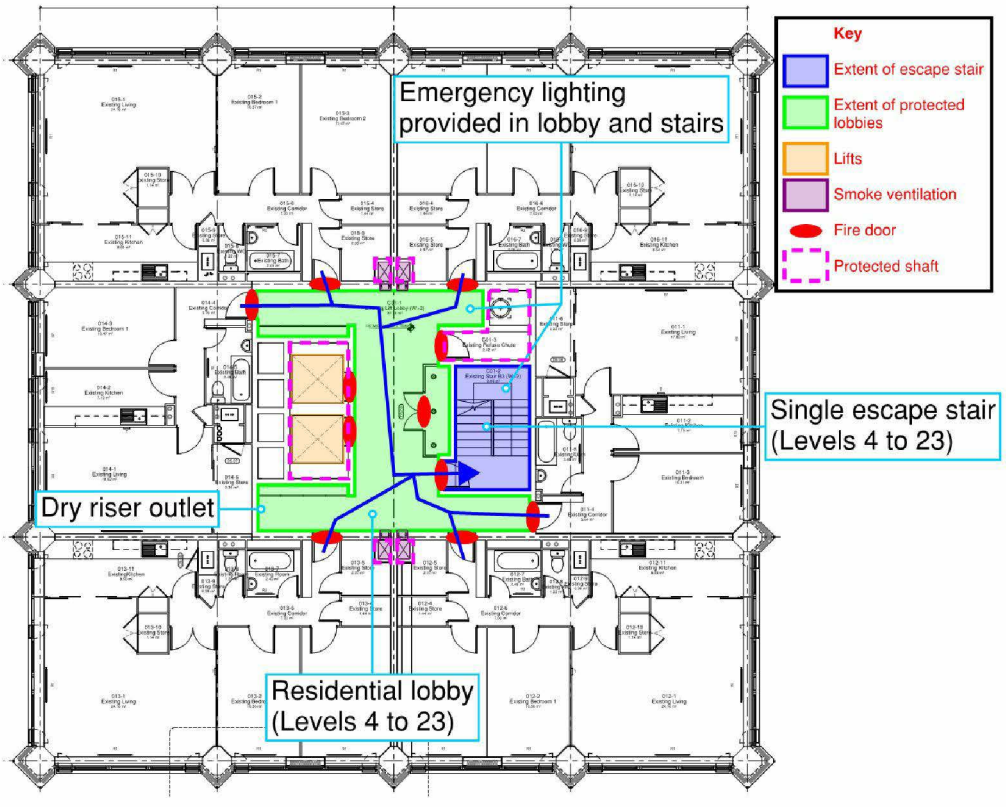


Figure 14.6: Stair and lobby location and features at Levels 4 to 23 (SEA00010474)

14.4 The protected stair

14.4.1 Evidence from post-fire damage site inspection

14.4.2 I inspected the condition of the stairs and stair doors on 6th October, 1st November and 7th November 2017 to 9th November 2017. My inspection team and I photographed every landing and half-landing level. Please refer to Appendix C for details of the post-fire building inspection referred to in this section.

14.4.3 I have categorised the damage that I observed within the stair using two criteria: soot disposition on walls and ceilings and heat damage to the plastic light fittings present in the stair. Table 14.1 describes the grading I have used for each.

Table 14.1: Criteria used for assessment of conditions within the stair

Criteria	Category Definition	Grade
Soot deposition	No observable soot on surfaces	None
	Light staining or soot depositions observed on surfaces (e.g. surface linings visible beneath)	Light
	Dark, thick staining observed on surfaces (e.g. black surfaces, surface colour not visible)	Heavy
Damage to the stair plastic light fittings	Stair light casing is intact and has not deformed	No damage
	Stair light casing is deformed, melted or completely missing	Plastic lights melted or destroyed

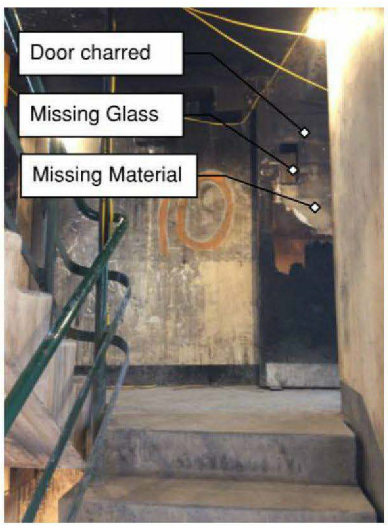
14.4.4 Table 14.2 describes the damage categories I have applied to doors and partitions. I have provided examples of the different categories for the doors in Figure 14.7.

Table 14.2: Door and partition damage assessment category definitions

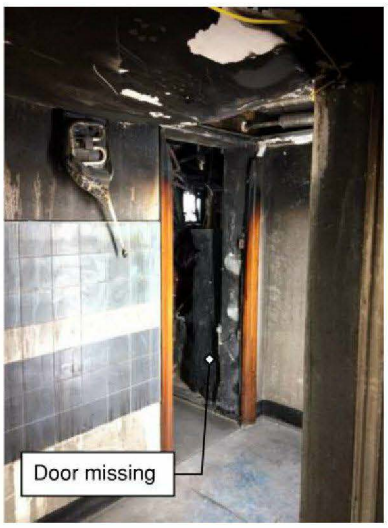
Damage Category	Category Definition
Not recorded	Door or partition was either obstructed during my site inspection or I do not have a clear photographic record in our survey records.
Intact	The door or partition itself does not appear to be damaged (e.g. charred or missing materials), although it may be discoloured and/or have soot deposition. The door fittings and/or fixtures may be damaged (i.e. letterbox, door frame).
Damaged	The door or partition itself is damaged (e.g. charred or missing materials) or glazing is breached (where applicable).
Missing	Door/partition is missing.

(a) Sample of door classed 'Not recorded'

(b) Sample of door classed 'Intact'



(c) Sample of door classed 'Damaged'



(d) Sample of door classed 'Missing'

Figure 14.7 (a) Level 9 (Flat 124) (b) Level 6 (Flat 96) (c) Level 10 stair door (d) Level 8 (Flat 116)

14.4.5 I have included examples in the diagrams in Figure 14.8, Figure 14.9 and Figure 14.10 of damage in the stairs and lobbies of Level 04, Level 13 and Level 23. I have carried out this exercise for Levels 04 – 23 of Grenfell Tower and full details can be found in Appendix C.

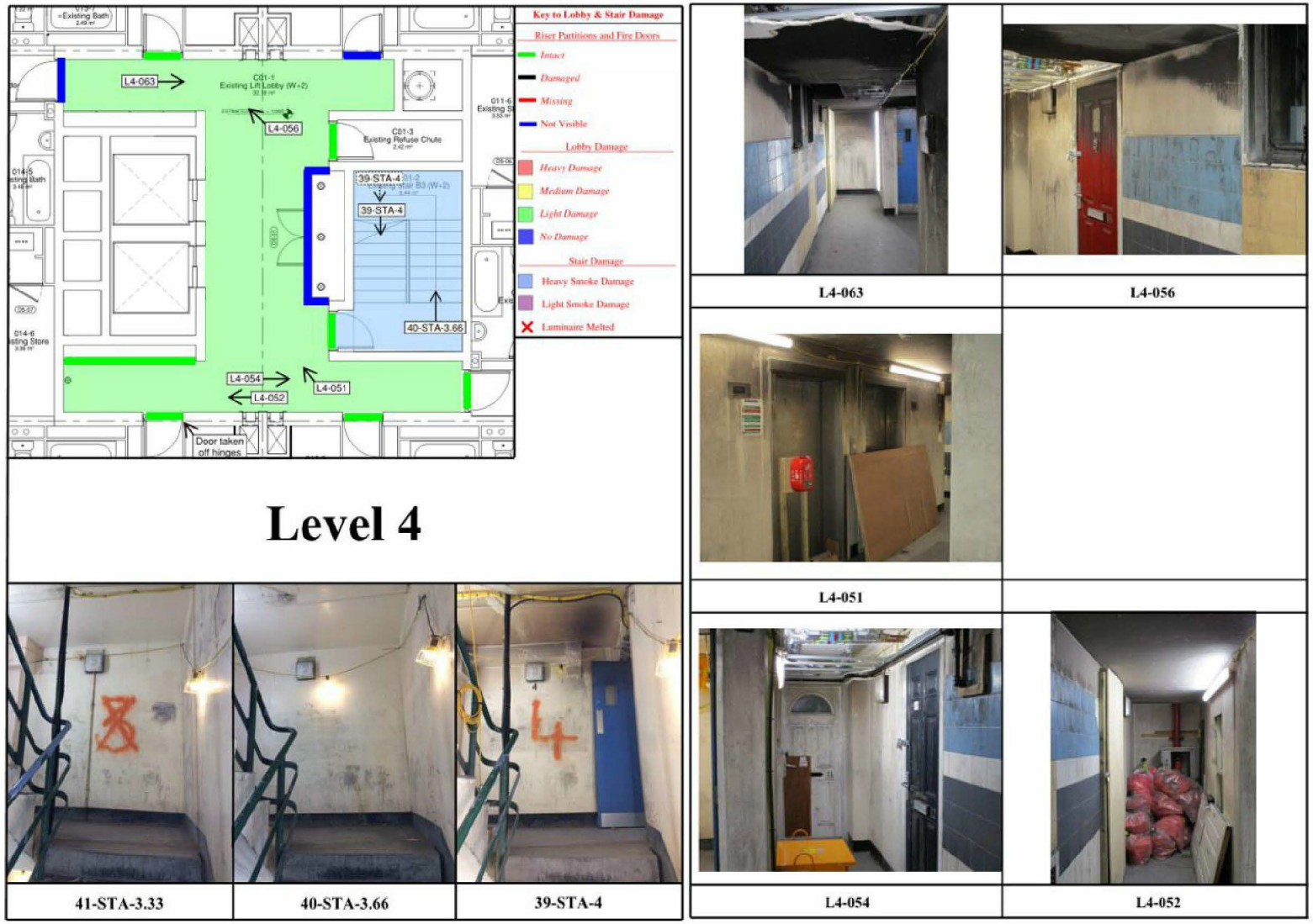


Figure 14.8: Record of stair and lobby damage from post fire site inspection – Level 04

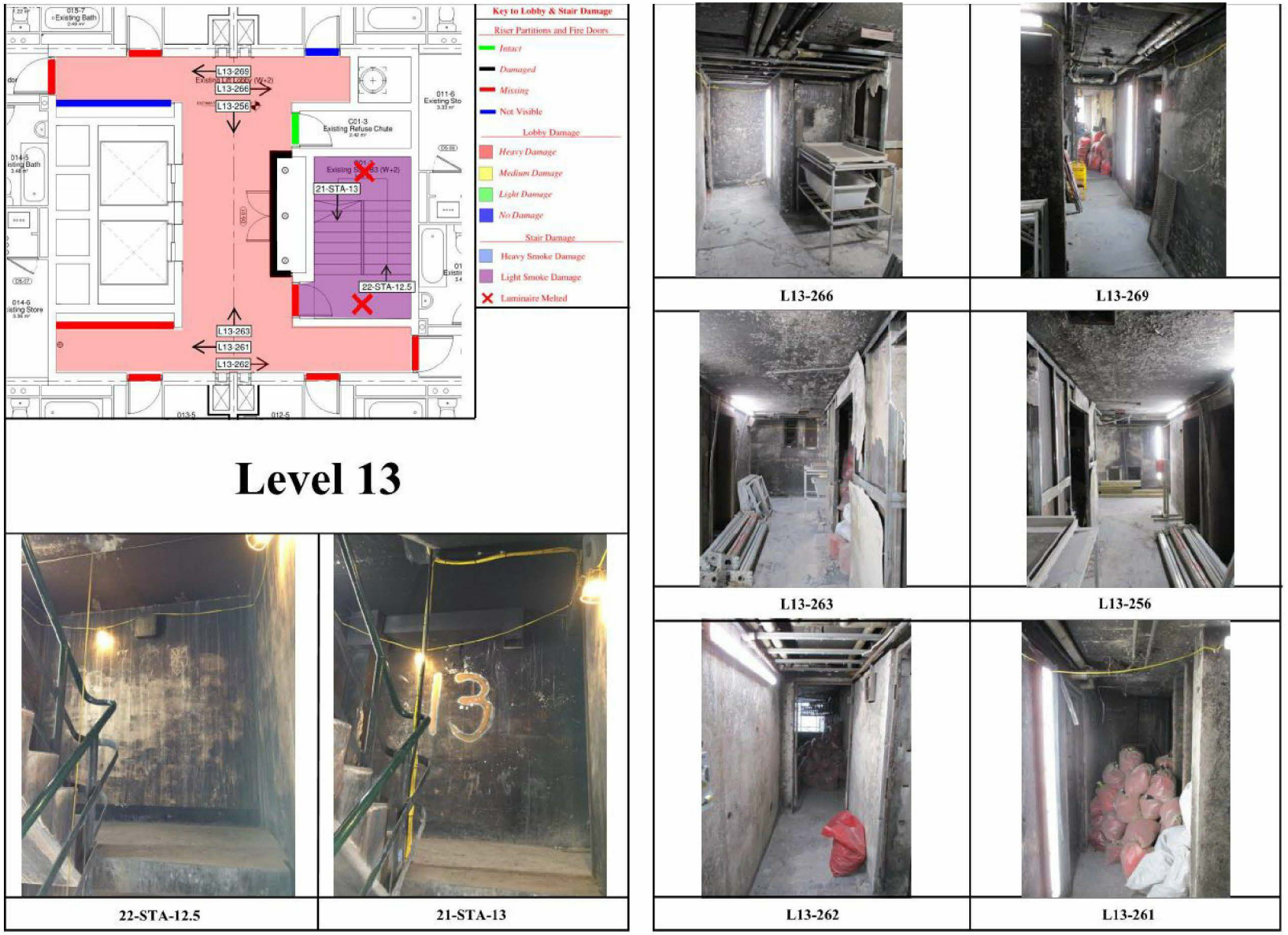


Figure 14.9: Record of stair and lobby damage from post fire site inspection – Level 13 (plan adapted from SEA00010474)

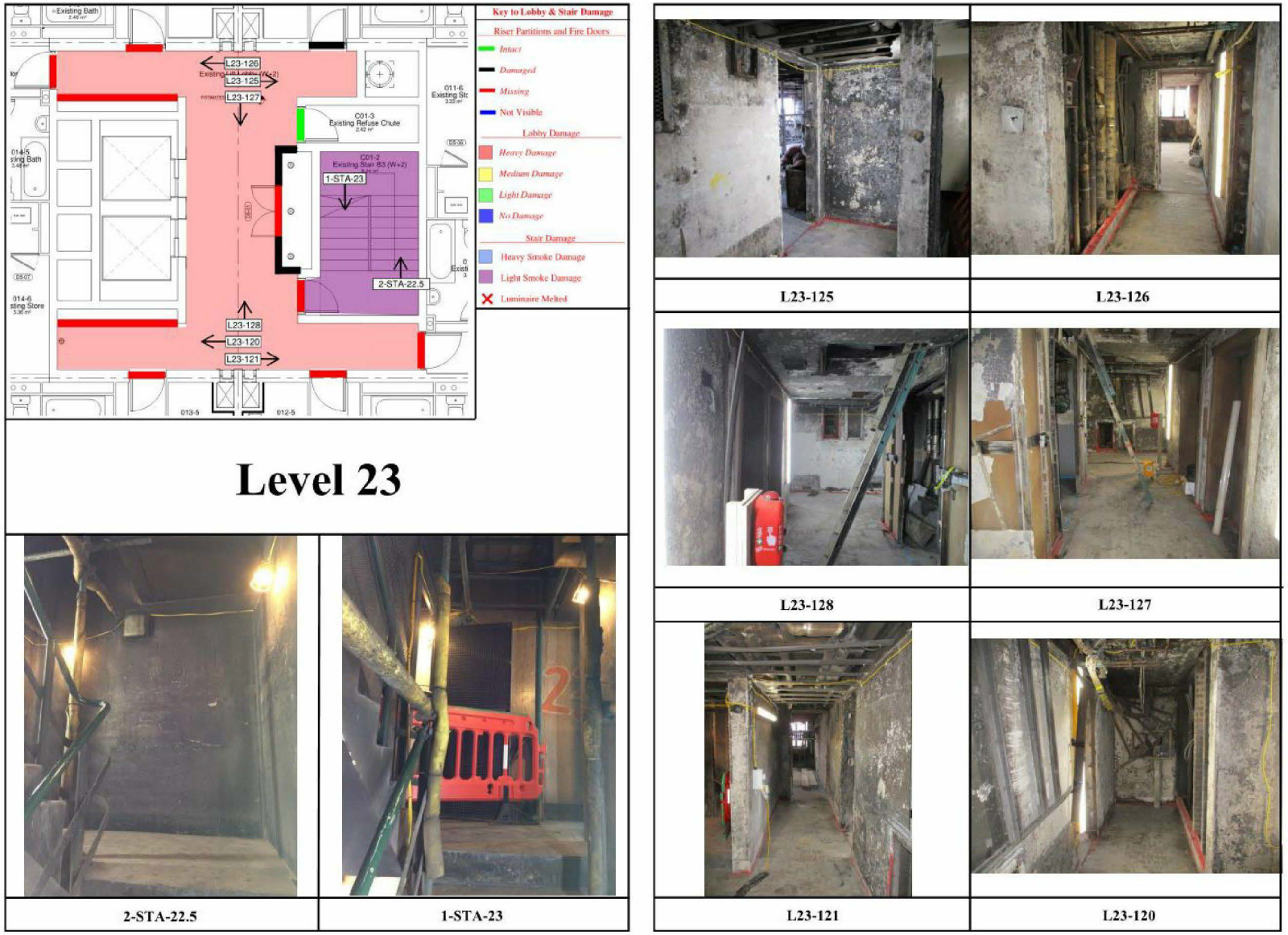


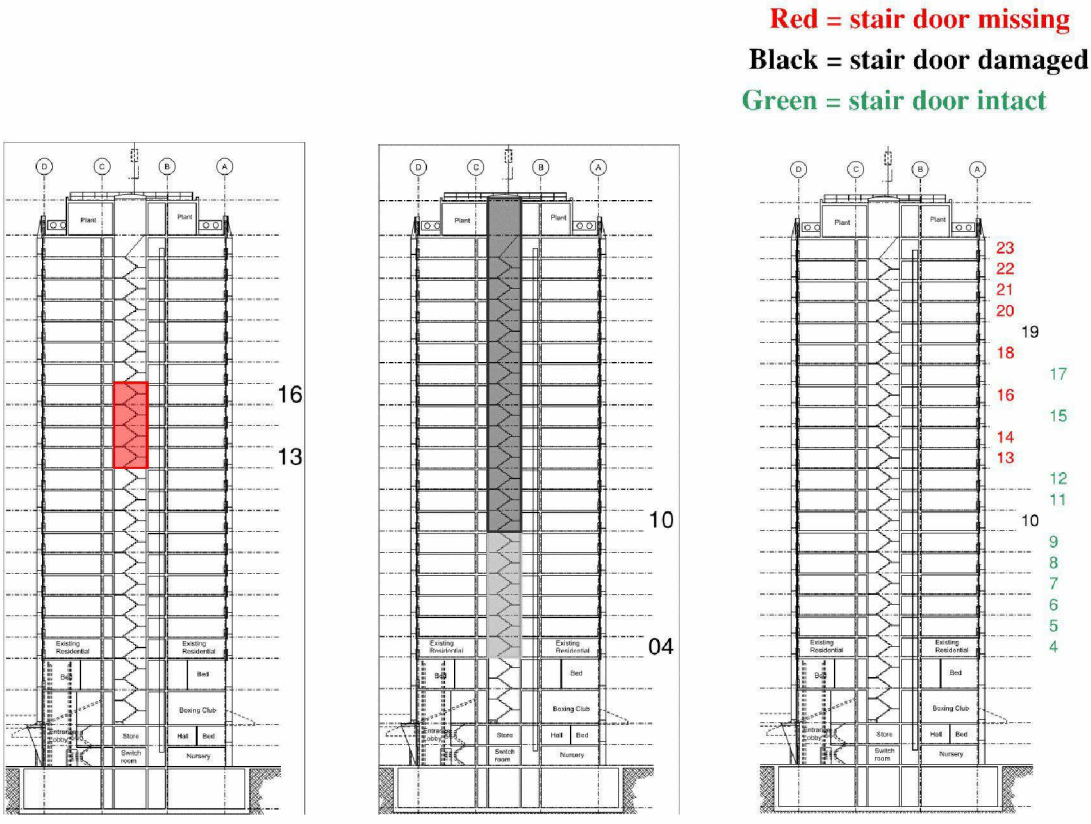
Figure 14.10: Record of stair and lobby damage from post fire site inspection – Level 23 (plan adapted from SEA00010474)

14.4.6 Resulting summary of observed damage in the stairs

14.4.7 In Figure 14.11 I have summarised the damage I observed within the stair at all levels using the stair light fitting damage criteria (Figure 14.11 (a)), soot deposition criteria (Figure 14.11 (b)) and the stairwell door damage assessment (Figure 14.11 (c)).

14.4.8 Figure 14.11 (a) shows that stairs between Levels 13 and 16 were exposed to temperatures above 150°C. This assessment is based on the condition of light fittings in the stairs which show evidence of softening, flowing and melting.

14.4.9 I have used this temperature limit because the glass transition temperature of polycarbonate (the plastic material in the lights) is listed by Table 7.1 of the SFPE Handbook of Fire Protection Engineering 5th ed as being 145°C. Above this temperature the material loses significant strength and stiffness, allowing it to soften. Table 7.1 of the SFPE Handbook also identifies the lowest melting point of Polycarbonate to be 215°C.



a) Levels in which damage to lights was observed -indicating exposure to high temperatures (>150°C)

b) Evidence of smoke damage post-fire (light grey – light smoke deposition, dark grey – heavy smoke deposition)

c) Condition of stair doors post-fire

Figure 14.11: Damage observed in stairs (SEA00009461)

14.4.10 Figure 14.11 (b) summarises the degree of smoke deposition observed in the stairs. Light smoke deposits were observed between Levels 04 and 09. From Level 10 to the top of the building, the stair was heavily stained with soot. Please refer to Appendix C for further photographic evidence of the stair condition from the post fire inspection.

14.4.11 Figure 14.11 (c) provides a summary of the damage observed to doors between the stair and the lobbies on each level of the building.

14.4.12 From my site inspections I observed stair doors were missing on Levels 13, 14, 16, 18, 20, 21, 22 and 23.

14.4.13 I have cross checked these findings with the MPS photographs taken straight after the fire for these levels (METS00017081, METS00017090, METS00016987, METS00017003, METS00017129, METS00017247, METS00019977, METS00020143)

14.4.14 These photographs indicate the stair doors on levels 16, 18, 22 and 23 were present immediately after the fire though in each case the door was badly damaged and no longer on their hinges; I have provided a sample of these photos for Level 16 and 18 in Figure 14.12.

Figure 14.12 MPS photographs of the stair doors it the immediate aftermath of the fire (a) Level 16 and (b) Level 18 – remains of door circled in red in each

14.4.15 The condition or location of the stair doors on Levels 13, 14, 20 and 21 is unknown as there is no evidence of the doors remaining during the post fire inspection. I believe these doors were present before the fire as I have found no evidence that stair doors were missing in the 2016 FRA (LFB00000066) or the Notification of Fire Safety Deficiencies Letter issued by London Fire and Emergency Planning Authority (TMO00832135).

14.4.16 Therefore, based on this evidence, where doors are noted as missing it is not possible to confirm whether they burned away or were knocked off their hinges during the fire, or were removed by firefighters or others after the fire ended.

14.4.17 Regardless, the post fire photographs clearly show severe damage occurred on those floors.

14.4.18 I consider the damage or loss of stair doors to be indicative of high temperature smoke and/or flames being present in the lobby for an extended period. However, as the stair light was only damaged on levels 13 to 16, the stair doors on Levels 18 to 23 must have been in place and providing some protection to the stair throughout the fire, even though after the fire they were missing or knocked off their hinges.

14.4.19 These conditions could have been caused by fires in combustible materials stored within the lobby itself – but I have found no evidence this was the case.

14.4.20 The conditions would also be caused by hot smoke and flames extending from flat(s) into the lobby, which I consider to be far more likely based on the evidence available to me. I have described the condition of the lobby and its effect on the stair door in Section 14.5.

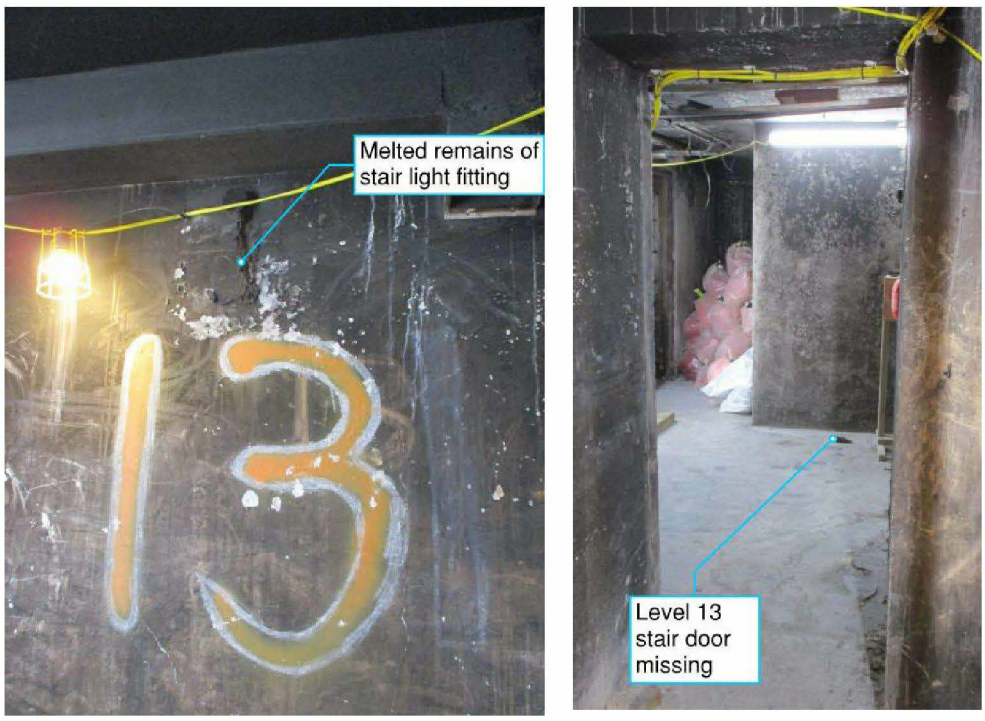
14.4.21 The pattern of stair door damage matches the general damage pattern, with the higher levels being more likely to display damaged or missing stair fire doors.

14.4.22 Level 15 is of particular interest because the light fitting in the stair is severely damaged, see Figure 14.13(a), yet the stair door immediately beside it is intact, Figure 14.13(b). This indicates the door leaf has maintained its integrity, but it is likely that hot smoke has still penetrated the stair at this level. This could be due to the door being open allowing smoke into the stair, or smoke reaching this level from lower down in the stair – noting the stair doors at Level 13 (Figure 14.14) and Level 14 (Figure 14.15) are missing, and the lights beside those doors are also melted.

14.4.23 The half landing lights are also melted between Level 13 and 16, so it is most likely the door at Level 13 was held open for a time, causing a flow of hot smoke up the stairs sufficient to melt the light at the landing above level 16.

(a) (b)

Figure 14.13: (a) Stair light fitting condition and (b) door condition on Level 15



(a) (b)

Figure 14.14: (a) Stair light fitting condition and (b) door condition on Level 13

Figure 14.15: (a) Stair light fitting condition and (b) door condition on Level 14

14.4.24 These three levels are unique therefore, within the stair, as the emergency lighting fixture has melted.

14.4.25 My principal site observations regarding the stair conditions are:

a) The stair shows light smoke damage from level 4 to level 9.

b) The stair shows consistently heavy smoke damage from level 10 to level 23.

c) From the evidence of the melted / destroyed polycarbonate light fittings, the temperature in the stairs was highest on floors 13 to 16. Polycarbonate softens above approximately 150°C, as described above. This was unique to these four levels.

d) Stair doors are intact or lightly damaged on floors Ground to 9, 11, 12, 15 and 17.

e) Stair doors are severely damaged on floors 10 and 19.

f) Stair doors were missing in both the MPS photographs and during my own site inspection, therefore the condition is unknown on Levels 13, 14, 20 and 21. These doors may have been completely destroyed by the fire, knocked off their hinges or removed by firefighters/others during or after the fire.

g) The stair doors on Levels 18 to 23 were either severely damaged or missing, however the light in the stair, directly adjacent to the doorway, was not damaged, other than being coated in soot.

h) The internal walls of the stair did not show any surface damage other than smoke deposition. Damage to light fittings is most likely a characteristic of smoke in the stair reaching temperatures higher than 150°C, from a lower lobby, rather than direct flame impingement through the door opening into the stair because the half landing lights between each of 13 – 16, were also melted. I did not observe any evidence which indicates extensive damage associated with a fire in the stair.

14.4.26 Evidence on conditions in the stair from the firefighter witness statements and LFB command logs

14.4.27 Having made these observations on site I wanted to see how they aligned with the evidence from London Fire Brigade, who had to use the stair throughout the fire event.

14.4.28 I therefore reviewed all or part of the fire brigade witness statements and oral hearing transcripts provided to me at the time of writing. I will continue to review any further evidence from firefighters made available to me.

14.4.29 I have reviewed this evidence from firefighters to understand the conditions in the stairs and lobbies, and therefore the performance of the fire safety measures in the building. My consideration of the firefighter evidence is not intended to be a forensic analysis of specific movements or actions of firefighters, as that is outside my remit and will be addressed by other experts in Phase 2.

14.4.30 From the witness statements available to me, I have analysed evidence from the firefighters listed in Table 14.3. I have chosen these specific firefighters as they provide commentary on the conditions in the stairs and lobbies in Grenfell Tower between the time of first LFB attendance at 00:59 and approximately 03:00. Based on the firefighter and resident evidence I have reviewed, by 03:00 it is apparent that significant smoke spread had occurred to lobbies on all levels above Level 4, and that the stairs were significantly affected by smoke from Level 2 up to Level 23.

14.4.31 Table 14.3 indicates the order of arrival, and approximate time of entry into the building. These times are based on the following sources:

a) the Breathing Apparatus telemetry information (LFB00023326);

b) Appliance attendance times recorded in the LFB Short Incident Log Report (MET00013830)

14.4.32 I have assumed that specific events recorded within the witness statements and oral evidence transcripts of individual firefighters have occurred at the start, end or at the mid-point of the recorded times of firefighters leaving and

then returning to the bridgehead (start and end of breathing apparatus wear times).

14.4.33 Several firefighters undertook tasks within Grenfell Tower before proceeding to wear breathing apparatus. In these cases, I have estimated a time of events based on the content of their individual witness statements and transcripts of oral evidence. Appendix N records excerpts of individual firefighter's witness statements and transcripts in chronological order, as I have relied upon them in this Section 14.

Table 14.3: Estimated times for arrival and entry into Grenfell Tower based on documentary evidence

Firefighter	Recorded time of arrival to site	Estimated time of leaving bridgehead wearing BA (logged onto ECB)**	Estimated time of return to bridgehead (end of BA wear)	Witness statement
Dorgu*	00:59	01:35	01:57	MET000086037
Badillo*	00:59	01:33	01:57	MET00010080
Batterbee	00:59	01:04	01:29	MET00005674
Secrett*	00:59	01:34	01:57	MET00005384
O'Beirne*	00:59	NA	NA	MET000083321
Hippel	01:08	01:18	01:38	MET000083300
Archer	01:08	01:21	01:40	MET00008001
Murphy	01:08	01:51	02:19	MET00010820
Roberts	01:35	01:57	02:21	MET00007890
Fernandes	01:39	02:01	02:27	MET000083292
O'Donoghue	01:39	02:21	02:40	MET000080591
Eden	01:40	02:02	02:27	MET00008019
Foster	01:40	01:54	02:27	MET00010084
Welch	01:40	02:03	02:29	MET00007525
Nelson	01:45	02:13	02:28	MET00007785
Flanagan	01:45	02:13 (estimated from Nelson telemetry data)	02:28 (estimated from Nelson telemetry data)	MET00007765
Yeoman	01:45	02:13	02:28	MET00007862
Batcheldor	01:45	02:18	02:33	MET00007511
Upton	01:47	02:45	03:07	MET00007524
Hoare	01:48	02:56	03:20	MET00008027
Goulbourne	Arrives at the Bridgehead at approx. 02:20	NA	NA	MET00010759
Roe	02:31	IC outside Grenfell Tower	NA	MET00007520

Firefighter	Recorded time of arrival to site	Estimated time of leaving bridgehead wearing BA (logged onto ECB)**	Estimated time of return to bridgehead (end of BA wear)	Witness statement
Moore	02:59	TBC	TBC	MET00010081
Graham	Approx. 07:55	NA	NA	MET00005257
George	TBC	Not determined	NA	MET00007768
Wolfenden (Peter)	01:26	NA	NA	MET00017428
Watson	01:25	NA	NA	MET00008044
O'Neill	02:12	NA	NA	MET00010758
Sephton	01:25	01:27	01:57	MET00010895
Desforges	01:46	02:04	02:30	MET00008013
Bell	01:08	02:10	02:29	MET00012995
Mitchell	01:47	Data not available	Data not available	MET000086063
Brown	00:59	01:04	01:28	MET00005251
Cook (Gareth)	01:38	04:04	04:28	MET00007882
Ellis	11:19	NA	NA	MET00005756
Stern		01:17	01:38	MET00012483
O'Loughlin	01:54	NA	NA	MET00012563
Gallagher (Ben)	01:26	01:42	02:17	MET00010083
		04:04	04:29	
Gillam	01:35	01:56	02:32	MET00008025
Smith	0215 (arrival time to Control Room, not to Grenfell Tower)	NA	NA	MET00007766
Murphy	01:08	01:51	02:19	MET00010820
Lawson	01:40	01:53	02:27	MET00010815
Cornelius	01:08	01:51	02:18	MET00012663
Merrion	01:35	01:51	02:15	MET000086060
Herrera	01:48	02:26	02:45	MET00010876
Orchard	01:47	02:27	02:47	MET000086069
Juggins	01:45	02:31	02:45	MET00010879
McAlonen	01:45	02:31	02:45	MET00012679
Codd	01:47	03:03	03:21	MET00012539
		05:22	05:47	
Wharnsby	02:21	03:04	03:17	MET000083336
Abell	00:59	01:21	01:39	MET000080558

Firefighter	Recorded time of arrival to site	Estimated time of leaving bridgehead wearing BA (logged onto ECB)**	Estimated time of return to bridgehead (end of BA wear)	Witness statement
O'Hanlon	01:08	01:11	01:35	MET000080592
Wood	02:28	03:47	04:02	MET00010928

* Note – Marked firefighters undertook tasks within the building before wearing breathing apparatus.

** Several firefighters went under BA more than once during the course of the fire. I have only included firefighters' BA wear times which are relevant to specific evidence relied upon in this section in Table 14.3.

14.4.34 The following key information has been extracted from the firefighter and resident witness statements and oral evidence transcripts that were available at time of writing this report:

a) Where and when firefighters reached different floors, particularly the upper levels, and the time that specific residents were able to escape from higher levels (which is presented in Table 14.4). This is because the largest numbers of residents died on the upper levels.

b) Extent and severity of smoke in stairs (relevant to visibility, and also the need for clothing to protect against heat and breathing apparatus).

c) The number of people and obstacles in the stair as noted by firefighters.

d) Width of the stair for access and egress.

e) Understanding, by individual firefighters, of their location and position in the building.

14.4.35 In the following sections I present the key observations I have extracted from firefighter witness statements, LFB command logs and resident witness statements, relating to conditions in the stair as they relate to items a) to e) above. Specific excerpts from this evidence are recorded in Appendix N. The information is summarised in the diagrams in Figure 14.17 to Figure 14.30.

14.4.36 Please refer to Appendix N for details of how I have approximated and referenced the times associated with firefighter evidence.

14.4.37 **Ability of firefighters to reach the upper levels**

14.4.38 I have reviewed records of firefighter movements and resident escape times. This is to aid my understanding of the availability and conditions of the stair.

14.4.39 Table 14.4 identifies the approximate times at which specific firefighters are recorded to have been present on specific floors in Grenfell Tower. I have relied on evidence from firefighters where timing exists, and to understand the highest floors reached by firefighters in the different time periods. This data also illustrates the spread of floors visited by firefighters.

14.4.40 If further evidence is presented of firefighter activity on floors above Level 12, especially after 03:00, then I shall revisit this analysis in the next phase of the Inquiry.

14.4.41 The cells marked in yellow identify when specific residents were able to escape from the building between 03:01 and 04:00.

14.4.42 Note that all residents of level 13 had evacuated by 01:28.

14.4.43 I have not included levels Ground, 1 and 2 in this table as they were not significantly affected by the fire.

14.4.44 Table 14.4 demonstrates that firefighters were apparently present in the upper floors of Grenfell Tower as late as approximately 03:00 (Upton reaching Level 19 at approx. 02:55). It also demonstrates that conditions in the stairs were such that it could be used as an escape route by residents from Level 21 with minimal protection (normal clothes and wet towels) at approximately 03:55

14.4.45 I have not yet been able to find any evidence to confirm if firefighters were assigned to go to, or otherwise reached, floors above Levels 13 between 03:01 and 04:00. At 03:01 there were 106 residents in the tower. There were 38 FSG calls recorded as starting between 03:01 and 04:00 (MET00014452).

14.4.46 After 04:00, there is no evidence that firefighters were able to reach, or pass beyond Level 13 for several hours. There were no FSG calls from above Level 13 after 04:00.

14.4.47 Specifically, the oral evidence of Gallagher (transcript 10th September 2018, p31) records that it was the opinion of Cook and Gallagher at approximately 04:15 that firefighters could not pass beyond level 12 with any certainty of being able to return. Level 13 up to Level 16, is where I found evidence of significant heat entering the stairs.

14.4.48 Additionally, no residents escaped from floors above Level 13 after 04:00.

Table 14.4: Levels where timed evidence exists of firefighters or residents present

Level	Witness	0058-0200	0201-0300	0301-0400	0401+
23	-	-			
22	Roberts		0215		
	Li and Liao			0321	
21	Roberts		0215		
	Gomes			0355	
20	Badillo, Dorgu, Secrett	0150			
	Eden, Fernandes		0210		
	Gillam		0215		

Level	Witness	0058-0200	0201-0300	0301-0400	0401+
19	Upton		0255		
18	Dorgu	0155			
	Foster, Lawson		0203		
	Yayha			0318	
17	Dorgu	0155			
16	Hippel, Stern	0130			
	Dorgu	0155			
	Macit			0347	
15	Badillo	0127			
	Dorgu	0155			
	Fairbairn			0354	
14	Murphy, Cornelius, Merrion	0200			
	Herrera, Orchard, Juggins,		0236		
	McAlonen		0240		
13	Dias	0128*			
12	O'Bierne	0123			
	Hoare		0300		
	Gallagher				0404
	Codd			0305	0527
11	O'Bierne	0123			
	Moore			0310	
10	O'Bierne	0123			
	Bettinson	0150			
	O'Donoghue		0225		
	Hoare		0300		
	Wharnsby			0304	
9	O'Bierne	0122			
	Bettinson	0142			
	O'Donoghue		0225		
8	O'Bierne	0122			
	Dorgu, Badillo	0140			
	O'Donoghue		0225		
7	O'Beirne	0122			
	Dorgu	0125			
	O'Donoghue		0225		
6	Stern, O'Beirne	0120			

Level	Witness	0058-0200	0201-0300	0301-0400	0401+
	Dorgu, Archer	0125			
	Hippel	0130			
	O'Donoghue		0225		
5	Stern, Hippel	0120			
	Abell	0121			
	Dorgu	0125			
	Abell	0140			
	Gallagher	0141			
	Wood			0350	
4	Badillo	0105			
	O'Hanlon	0111			
	Hippel	0117			
	Stern	0118			
	O'Hanlon	0135			
	Wood			0347	
3	O'Hanlon		0213		

*Dias is the last recorded evacuation from level 13

14.4.49 The oral evidence transcripts of Wolfenden (11th September 2018), Egan (4th July 2018), Watson (24th July 2018) and Goulbourne (12th September 2018) also identify the following key events that identify limits on the ability of firefighters to reach higher floors:

a) Approximately 04:25 – Wolfenden and Welch have a discussion resulting in agreement to try to get firefighters up to Level 15. The result of this discussion is recorded on a white board in CU7 (MET00015925, excerpted below). By this time there had been 58 FSG calls recorded from floors between Ground and Level 15. After 04:25 only 5 of the residents still in the tower were rescued, all from Level 10 or 11. However, as I describe in Table 14.10, there were only 7 fatalities of residents who lived between Ground and Level 15, and therefore the majority of residents who made FSG calls from Level 15 or below were able to escape the building.

b) Approximately 04:45 – In his oral evidence, Egan records a communication from Wolfenden that crews will not be committed above Level 11 (MET00015925, excerpted below). There were no FSG calls from above Level 11 at that time.

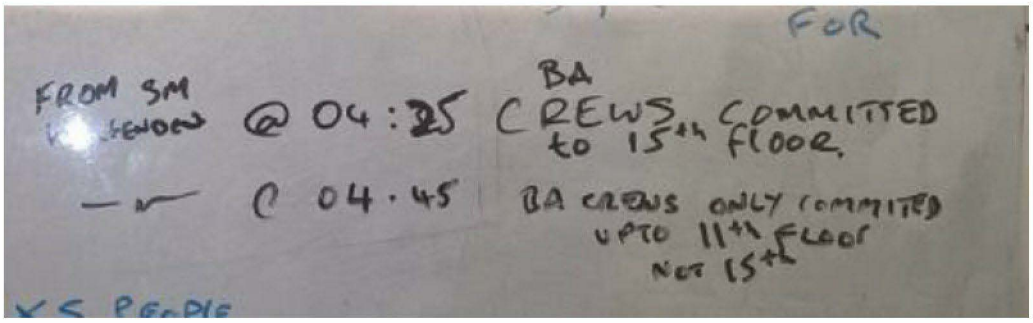


Figure 14.16: Excerpt from MET00015925 recording the times at which restrictions on crew movements were imposed

14.4.50 Descriptions of visibility and heat within the stair:

14.4.51 Appendix N provides specific evidence of the conditions of heat and smoke experienced within the stair of Grenfell Tower. This evidence is drawn from firefighter and resident witness statements and the transcripts from firefighter oral evidence.

14.4.52 The specific firefighter evidence I have relied upon in Section 14 is listed earlier, in Table 14.3. The specific resident evidence I have relied upon in Section 14 is listed below in Table 14.5

Table 14.5: Resident witness statements I have relied upon

Resident	Flat	CCTV time of exit (MET00016072)	Transcript	Witness statement
Ali	125	01:23:20	*	IWS00000002
Al-Arasi	102	01:26:10	Read only	IWS00000005
Ahmed F.	164	02:25:57	*	IWS00000729
Ahmed M.	102	01:21:46	*	IWS00000014
Ahmed S.	156	01:31:30	Read only	IWS00000388
Burton N.	165	02:32:46	*	IWS00000747
Khalloud	85	01:27:39	*	IWS00000473
Yahya	152	03:18:45	*	IWS00000498
Liao	195	03:21:43	*	IWS00000505
Li	195	03:21:28	*	IWS00000515
Laci S.	65	02:19:21	Read only	IWS00000818
Alves M.	105	01:08:34	4th October	IWS00000538
Gomes M.	183	03:55:03	*	IWS00000622
Jafari	86	01:22:26	8th October	IWS00000683
Lukic	84	01:49:07	10th October	IWS00000770
Smith	95	02:40:47	*	IWS00000771
Doulova P.	174	01:41:31	17th October	IWS00000835
Oyewole	113	02:46:02	15th October	IWS00000852
Patel	56	01:24:57	*	IWS00000855
Neda F.	205	02:43:31	18th October	IWS00000887
Neda S.	205	02:42:10	18th October	IWS00000886

Resident	Flat	CCTV time of exit (MET00016072)	Transcript	Witness statement
Macit	133	03:47:13	*	IWS00000904
Mekonnen	163	01:32:25	9th October	IWS00000912
Fletcher R.	131	01:31:31	11th October	IWS00000913
Ho	76	01:26:58	*	IWS00000925
Chebiouni	66	01:21:46	*	IWS00000944
Kassemdjian	141	01:26:50	Read only	IWS00000951
Zeda	53	01:11:57	Read only	IWS00000989
Smith R	95	02:41:44	*	IWS00000902
Elgwahry	196		Read only	IWS00000988

* - Note: Witness has not yet conducted oral evidence, or had evidence read into the record.

14.4.53 I have organised this evidence into chronological order of observations made by the individuals. The timing of these observations has been calculated based on the recorded time of leaving and returning to the bridgehead for firefighters from the BA telemetry (LFB00023326), and time of leaving the building for residents from the CCTV (MET00016072). In making these calculations I have had to make the following assumptions about the time firefighters would take to travel up the Tower:

a) Approximately 5 minutes to climb up to Level 12

b) Approximately 10 minutes to climb to Level 23

14.4.54 This is to help me start to frame the timing of observations only.

14.4.55 I understand that not all firefighters had the opportunity to carry out such a journey either without interruption or at that precise pace.

14.4.56 As I have already stated, my estimation of timings is imprecise and should not be assumed to represent an accurate determination of timings of events.

14.4.57 My conclusions, therefore, relating to conditions of visibility and heat within the stair are as follows:

a) According to several resident witness statements, there was smoke in the stair before 01:42, but 114 residents escaped from all levels (except 22 and 23) before 01:42.

i. Between 01:21 and 01:30, Naomi Li looked into the stair on Level 22 and said there was "*hazy smoke in the staircase at that point*"

ii. At 01:32, Richard Fletcher escaped the building (MET00016072) from Level 16. On entering the stair he observed smoke above him (IWS00000913). On descending he reports that smoke came into the stairs as residents escaped from lobbies affected by

smoke. As he approached Level 6 he reports smoke coming up from below.

b) Several residents explained that the conditions within the stair got progressively worse as they descended the stair:

i. At 01:26, Mesrob Kassemdjian escaped the building (MET00016072) from Level 17. In his witness statement (IWS00000951), he explained that there was no smoke in the stair at Level 17 but he observed white smoke at Level 14 and the conditions got progressively worse as he descended the stair (observation at approximately 01:20).

ii. At 01:32, Meron Mekonnen escaped the building (MET00016072) from Level 19. In her witness statement (IWS00000912), Meron Mekonnen explained the conditions in the stair:

"As we were walking down the stairs, the smoke was becoming thicker and thicker. It was dense and dark grey but I could see through it. I was able to breathe without any difficulty." (IWS00000912)

"No, the smoke first, I noticed the smoke was getting a bit darker grey. And then as I went further down, I noticed some of the doors were slightly open because there were fire hoses going through them, and I can see a dark -- really, really dark, thicker smoke coming up from above the door into the stairwell." (Transcript 9th October, p29)

iii. At 01:41, Petra Doulova escaped the building (MET00016072) from Level 20. In her witness statement (IWS00000835), Petra Doulova explained that the smoke became progressively thicker as she descended the stair and there was poor visibility in the stair:

"The visibility in the stairwell was poor, but I could make out the steps, handrail and my feet as I was looking down watching where I was putting my feet."

iv. I note that resident Ho (IWS00000925) specifically states that there was no smoke on the stair as he escaped at approximately 01:27. This conflicts with statements from other eyewitnesses. I cannot resolve this conflict with the evidence I currently have available.

c) According to firefighter and resident witness statements, visibility deteriorated first at levels in the middle of the stair between Levels 6 and 15:

i. Flanagan (MET00007765) reported clear air at the top and bottom of the stair when he ascended at 02:13. Nelson (MET00007785)

stated that conditions were significantly worse between floors 4 and 7 at 02:13.

ii. At 01:49, Branislav Lukic escaped the building (MET00016072) from Level 11. In his witness statement (IWS00000770), he explains that there was smoke in the stair but it was grey and thin in comparison to the thick, black smoke he observed in the Level 11 lobby. He also notes that the smoke "*became clearer towards the bottom, with less and less smoke.*"

iii. In her witness statement, Sharon Laci (IWS00000818) explained that the stair was *"full of smoke"* between Level 2 and Level 9; she escaped the building at 02:19 (MET00016072) and explained the visibility within the stairs:

"I had to feel for the steps to make sure I was stepping in the right place.

...

"A combination of the smoke and my eyesight meant I could only see an outline of the firemen guiding me down. It was very smoky, so I could not tell if the lights were working or not."

d) There are conflicts between observations from firefighter witness statements between 01:57 and 02:20.

i. Specifically, Dorgu and Badillo reported at approximately 01:57 that the stair was hot and filled with dense smoke from Level 20 down to Level 3. Additionally, Fernandes (MET000083292) identified that the smoke and heat within the stair intensified as he ascended the building between Levels 14 and 20 at approximately 02:01am.

ii. However, at approximately 02:13 Flanagan (MET00007765) observed on ascending the building that after Level 15 conditions in the stairs eased with no smoke being visible at all. In his oral evidence on the 23rd July 2018, Roberts also identified that at approximately 02:20 the stairs between Levels 10 to 20 were relatively clear of smoke.

iii. Because there are no resident statements above Level 11 in the time period 01:41 to 02:25 I cannot resolve the conflict in the firefighter witness statements. However, the fact that no residents escaped from above Level 11 in this period indicates that conditions in the lobbies or in the stairs on the upper floors were such that residents did not feel able to escape.

iv. Resident witness statements near in time to this period indicate that there was significant smoke in the stair below Level 11 within this time period. I have included this fir additional insight.

v. Branislav Lukic observed thin, grey smoke at Level 11 and below in the stair around 01:49 (IWS00000770).

vi. Sharon Laci indicated there was reduced visibility in the stair at Level 9 and below around 02:19 (IWS00000818).

e) Evidence from 02:19, up to 02:32, indicates that there was significant smoke in the stair up to at least Level 19.

vii. At approximately 02:25 (MET00016072), Fadumo Ahmed was carried out of the stair by a firefighter after being overcome by smoke in the stair (IWS00000729).

viii. At 02:32, Nicholas Burton escaped the building (MET00016072) from Level 19. In his witness statement (IWS00000747), he explains that there was smoke in the stair and there was no visibility. He explained that the handrail in the stair got hotter as he descended the stair, until he could no longer hold it.

f) Witness statements from both the firefighters and the residents indicate that the stair was filled with thick smoke on all levels between 02:25 and 02:45. Residents observed both poor visibility and heat in the stair during this time period.

i. Fernandes (MET000083292) describes his descent from Level 20 to Level 3 at approximately 02:25 and identifies that the stair was filled on all levels with dark smoke.

ii. Upton (MET00007524) ascended the stairs to Level 21 at approximately 02:45 and also identified poor visibility on all levels.

iii. Nicholas Burton (IWS00000747) explained that there was smoke in the stair and it was hot from Level 19 down before 02:32.

iv. At 02:41, Roy Smith escaped the building (MET00016072) from Level 12. In his witness statement (IWS00000771), Roy Smith explained that there was no visibility and considerable heat in the stair:

"When we pushed the staircase door open it was roasting, it was so hot. You could not see anything on the stairs"

v. At approximately 02:42, Farhad (Shekeb) Neda escaped (MET00016072) the building from Level 23. In his witness statement (IWS00000886), Farhad (Shekeb) Neda explained the conditions within that there was no visibility in the stair from Level 23 due to thick, black smoke.

vi. At approximately 02:46, Rosemary Oyewole escaped (MET00016072) the building from Level 14. In her witness statement (IWS00000852), Rosemary Oyewole explained that

there was no visibility and considerable heat in the stair before 02:46.

"The stairwell, like the corridor, was absolutely sweltering. It was like walking into a furnace, relentless and unstoppable heat pounding at my face and my skin. Coupled with that was the smoke; all-consuming and stale-smelling smoke."

g) There is specific evidence from resident Ahmed (IWS00000014) that smoke was coming from the Level 4 lobby into the stair by 01:21. This would indicate that the smoke control system was not functioning as intended. Therefore conditions of visibility in the stair were worse than would have otherwise been the case if it had functioned. Please refer to Appendix J for my assessment of that system.

h) There is evidence that firefighters were unable to access the floors above Level 11 to respond to fire survival guidance (FSG) calls from residents after approximately 04:15, because of the conditions within the stair (Goulbourne, MET00010759). I note that the last FSG call from residents on levels above Level 13 ended at approximately 03:33. The last resident escaped from above Level 11 at 03:55 (MET00016072)

14.4.58 Based on the evidence presented above and in Appendix N, I have identified that light grey smoke was observed in the stair by residents as early as 01:20.

14.4.59 According to firefighter witness statements, they perceived that conditions within the stair began to deteriorate rapidly between 01:35 and 01:40.

14.4.60 Some residents had begun to move up the building by this time; refer to Section 14.5.

14.4.61 Some residents reported that smoke became progressively thicker as they descended the stair after 01:40.

14.4.62 Between 01:49 and 02:18, no residents escaped from the building above Level 3 (MET00007765).

14.4.63 From 02:20 to 02:40 residents reported increasing smoke and heat in the stairs.

14.4.64 Firefighters reported heat in the stair by approximately 01:57.

14.4.65 I address the issue of open stair doors, with reference to a specific incident which appears to have occurred around 02:00 in Sections 14.4.77 and 14.4.166.

14.4.66 **Descriptions of debris and obstacles within the stair later in the fire**

14.4.67 Between 01:15 and 01:40, Archer (MET00008001, excerpted below) reports that hoses were being run in the stair. This would present an obstacle to people using the stairs. This would also allow smoke to pass into the stair where the hoses blocked open the stair door.

"The hose on the 6th floor came from the outlet on the fifth floor, not the sixth. This was a problem because the stairwell filled with smoke from the sixth floor because the hose prevented the door to the stairwell closing"

14.4.68 With regard to obstacles in the stairs, at approximately 02:00 O'Donoghue reported (MET000080591, excerpted below) casualties, and firefighters descending with casualties, as making ascent of the stairs more difficult. Additionally, equipment is reported on the floor.

"We continued upwards and between the 5th and 6th floor 2 Firefighters carrying a woman passed us. The woman was unconscious and was being dragged by the Firefighters

...

On about the 7th or 8th floor 2 more Firefighters came down the stairs and we have had to squeeze into the corner to give them room to pass. I don't know if they were carrying any causalities as I was facing into the corners of the stairwell. I didn't see them coming at first but I heard them as they were shouting. We gave them right of way as they might have been low on air or be carrying a casualty.

...

There was a lot of equipment on the floor so we had to walk carefully so as not to trip. Due to lack of visibility we had navigate a lot by touch and land marking which is where we make a mental note of where things are as we move."

14.4.69 Batcheldor was traversing the stairs at approximately 02:15 (MET00007511, excerpted below). This statement identifies that the stairs contained discarded firefighter equipment and resident clothing.

The stairway was a complete mess. It was littered with pieces of equipment which firefighters had abandoned in order to help get people out of the building. There was also a lot of discarded clothing. I expect this clothing was used by people to wrap around their faces in order to protect themselves from the

14.4.70 Fernandes records at approximately 02:40 (MET000083292, excerpted below) that descent of the stairs was obstructed due to the presence of firefighters assisting casualties.

"There were initially no obstacles on the staircase, however as we descended we came across a set of three firefighters struggling with an unconscious adult casualty. One of the firefighters saw me and asked for help, they couldn't see that I had the child in my right arm. The lights started to come on at around the 3rd floor and visibility improved. There was a bottle neck and the firefighters in front of us were struggling. I could see they each had a limb of the adult casualty who was a large male. A firefighter was shouting at me to pass the child over the adult male, I now know this was Firefighter Williams, he must have got past me and the other firefighters with the adult casualty somehow. I passed the child from my right arm to Firefighter Williams. I could see that the child was unconscious and frothing at the mouth"

14.4.71 Upton traversed the stairs at approximately 02:45, and reported (MET00007524, excerpted below) that the stairs contained firefighter equipment and items of clothing that had been discarded. Upton also identifies that as well as causing a physical blockage, discarded items on the stairs slowed down firefighters who had to check that the items were not casualties lying on the floor.

> We climbed and climbed and climbed. There were a significant number rags all over the stairs - obviously people had come out of the building holding scarves over their faces and things had been dropped. There were also items of firefighter's equipment which had been piled on the landings, such as hoses. There was
>
> debris all over the stairs which we couldn't just walk past in case it was a person. We had to take our time to make sure we didn't miss anyone. I was feeling my way with my feet and my hands. When I got to a pile I would get down on my hands and knees to check it. We couldn't see anything so we were doing everything blind.

14.4.72 The witness statements of O'Neill (MET00010758) and Welch (MET00007525), excerpted below, identify that fatalities in the stairs also led to obstruction of firefighters using the stairs. I have estimated that this specific event occurred at approximately 02:30.

14.4.73 O'Neill (MET00010758)

> Our efforts throughout were hampered by the size of the stairwell which was surprisingly small. It was so narrow that 2 firefighters in BA could not walk side by side. Unfortunately there were also a number deceased persons in the stairwell which made it difficult to negotiate. A bariatric lady deceased on the 9th floor stairwell had become a barrier and so I asked a BA crew to move her, but also I felt she deserved some dignity and should be respected. They were able to move her and I was very glad.
> Because there was only one (1) stairwell our own hoses also took up room in there. When they were taken through the fire doors to fight fires on each floor it also allowed smoke into the stairwell reducing visibility. I was not aware of any smoke extraction system being present. Some of our hoses were burst by the falling debris outside.

14.4.74 Additionally, Welch (MET00007525) stated

> Page 9 of 10
> With only one (1) staircase it made our job a lot tougher. BA crews were struggling to get up and down with casualties because of bodies, hoses all in the same stairwell. On the 9th floor the body of a large deceased lady could just not be physically moved. With the hoses in the stairwell it also meant that the lobby doors were held open and this allowed smoke into the stairwell. I used a Positive Pressure

14.4.75 On ascending the stair at approximately 02:56, Hoare reported (MET00008027) obstacles in the form of personal belongings left on the stairs.

"I was stepping on what I believed were personal belonging as we made our way up to the 12th floor"

14.4.76 My conclusions, therefore, relating to debris and obstacles within the stair are as follows:

a) As presented above, observations were recorded of debris, casualties and discarded equipment within the stair that hampered the progress of the firefighters on the stair, after approximately 02:00. This was compounded by the lack of visibility.

b) The witness statements also provide evidence that firefighting operations, including the use of hoses from lower floors (i.e. Level 6), allowed smoke into the stair.

c) I note that the majority of residents on the stairs occurred during the time period 0055 - 0140. The stairs therefore were relatively clear for a further 20 minutes. I address stair capacity in Section 16 of my report.

14.4.77 Evidence of stair fire doors being opened temporarily and being jammed open

14.4.78 The opening of stair fire doors is important evidence relating to 2 specific issues related to conditions in Grenfell Tower on the 14th June 2017. These are:

a) Stair fire doors opened temporarily to allow residents to escape and firefighters to enter lobbies, permits smoke to enter the stair from lobbies, for a limited period, but can cause some reduced visibility and increasing risk from exposure to toxic gases; and

b) Stair fire doors held or blocked open also permits heat to enter the stair, for example potentially contributing to the "hot zone" conditions in levels 13 – 16.

14.4.79 As identified in Figure 14.17 to Figure 14.30, which follow, smoke was present in lobbies on floors other than the fire floor (Level 4) early in the fire. Therefore, whenever the stair doors to these other levels were opened some smoke could enter the stairs.

14.4.80 Based on the evidence available, smoke began to enter the lobbies on floors above Level 4 from approximately 01:18. Additionally, the stairs became significantly affected by smoke with visibility decreasing from approximately 01:40, and particularly after 02:00 (as seen in Figure 14.22).

14.4.81 Between approximately 01:20 and 01:40, there is evidence of significant smoke spread to the protected lobbies on 13 additional floors above the initial fire floor on Level 4. These are Levels 5, 6, 7, 8, 10, 11, 12, 15, 16, 19, 20, 21 and 22.

14.4.82 Between 01:20 and 01:40 there are 63 residents recorded as leaving Grenfell Tower from Levels 5, 6, 7, 8, 10, 11, 12, 15, 16, 19, 20, 21 and 22, and these residents will have opened the stair doors between smoke affected lobbies and the stairs temporarily, permitting some smoke to enter the stairs.

14.4.83 Between 01:20 and 01:40 there were 15 firefighters recorded as having passed beyond the bridgehead at Level 2. During this time significant firefighting operations are recorded as occurring on Levels 4, 5, 6, 16 and 20.

Additionally, at least one firefighter briefly visited Levels 7, 8, 9, 10 11, 12 and 15. Smoke was recorded in each of these lobbies during this time. Again stair doors would have been open during these activities, at certain times.

14.4.84 Between 01:40 and 02:15 the number of firefighters passing beyond the bridgehead increased from 15 to a peak of 28. This increase in firefighter numbers would have resulted in doors between smoke affected lobbies and the stairs being opened, permitting some smoke to enter the stairs. During this time period a further 16 residents are reported as evacuating. The smoke movement from the lobbies into the stairs which occurred during this time is therefore more likely to be associated with firefighter operations rather than resident escape.

14.4.85 There is evidence (transcript 23rd July 2018, p72) that firefighters would pause after opening stair fire doors, into lobbies that were filled with smoke with zero visibility. The specific crews would then either shout into the lobby and wait for a response, or they would pause and decide within the team what action to take next.

14.4.86 There is also evidence that other firefighters, such as Hippel (Transcript 19th July 2018, p44), would open a door onto a smoke filled lobby and then immediately close the door again to prevent the smoke getting into the stair.

14.4.87 There is evidence of firefighter activities blocking open doors between the stairs and the lobbies as follows (please refer to Appendix N for full evidence in chronological order):

a) At approximately 01:12, a hose was laid from Level 3 through the stair door into the Level 4 lobby.

b) At approximately 01:30, Archer (MET00008001) observed that the hose that he was using to fight the fire on Level 6 came from the dry rising main outlet on Level 5, therefore blocking open the stair doors on both Levels 5 and 6.

c) At approximately 01:30, resident Meron Mekonnen observed that at least two stair doors were blocked open by fire hoses and *"darker, thicker smoke was coming from these doors"*. (Transcript 9th October, p35).

d) At approximately 01:38, O'Beirne observed that the conditions within the stair was being made worse due to a hose blocking the Level 4 stair door. (Transcript 3rd July 2018, p20)

e) At approximately 01:45, Sephton (MET00010895) records that there were hoses laid from the dry rising main outlet on Level 4 running up to Level 5, and therefore blocking open the doors on both Level 4 and Level 5.

f) At approximately 02:10, Desforges (MET00008013) reported that he instructed his BA partner to hold the stair door open while he searched the lobby as he was concerned he would not be able to find his way back

to the stair if the door was closed. The statement is not clear on how long the door was left open. Desforges stated that it was a floor between level 10 to 14, and later clarifies in his oral evidence that they (him and his team) "*strongly believe it was the 10th floor*" (Transcript 31st July 2018, p170). I am unclear what evidence this belief is based on. It would have been open for several minutes as Desforges was undertaking search and rescue while crawling on the lobby floor.

g) At approximately 02:15, Bell (transcript 11th September 2018, p47) records:

"I think it was eventually the 12th floor we got to. I heard another crew a floor or two below me, shouting. They were doing 'door procedure' — when crew shout loudly to alert others as they break through a door. The three of us made our way to this crew...

h) In both Desforges and Bell' s transcripts they refer to a cat being passed from within the lobby to the stair from one team to another so it is very likely they were referring to the same floor

i) At approximately 02:21, O'Donoghue (transcript 23rd July 2018, p22) specifically observed a halligan bar being used to block open the stair door at approximately Level 9. O'Donoghue does not state how long the bar was in place. Additionally, O'Donoghue recalls in his oral evidence (Transcript 23rd July 2018, p27) *"Some of the doors have been blocked open by discarded equipment which was letting the smoke in."*. No further details are provided with respect to number or location of these doors.

14.4.88 The intense heat from the lobby on this level at this time is reported by both Desforges within the lobby itself and by Bell who was one or two floors further up the stairs at the time of the stair door opening:

Desforges: *"Immediately on entry, I knew that it was incredibly dangerous conditions"* (Transcript 31st July 2018, p173)

Bell: "*"Did anyone else hear that, sounds like 3 a crew's doing door procedure?" And as I'm saying it, they must have opened a door, because the stairs -- it was smoky before, but it just filled with hot, black smoke, like visibility went to nothing."* (Transcript 11th September 2018, p48)

14.4.89 This evidence shows how firefighting operations could have introduced significant heat and smoke from the lobbies into the stairs, and been one cause of the 'hot zone' which I describe elsewhere in this chapter.

14.4.90 **Descriptions of the width of the stair**

14.4.91 Specific details of the design and width of the stair are provided in Appendix H.

14.4.92 The witness statements I have presented below identify how the width of the stair impacted the ability of firefighters to undertake firefighting and search and rescue operations on the 14th June 2017.

14.4.93 The statement of Batcheldor (in Fire Sector 02:17-02:33, MET00007511) identifies that the stair was too narrow for ascending and descending firefighters to pass each other easily. In particular, it identifies that firefighters in breathing apparatus cannot easily make more room in a narrow space by turning sideways due to the presence of the equipment on their backs.

> As we were going up other firefighters with casualties were coming down shouting," Casualty! Casualty!" as we are trained to do. This is a signal for people to move out of the way and give them priority. The stairwell was narrow with tight turns and it was very difficult to make space as we could not get our backs flat against the wall as we had the breathing cylinders on our backs. People were desperate to get their casualties out of the building and we were desperate to get up the tower to get more residents outs. It seemed to take ages for us to get up the building as we kept having to stop and try and get out of the way. All the time was trying to get my head around what was happening. It was crazy.
>
> ...
>
> The stairwell's narrowness was problematic. I have been in narrow stairwells before, but the traffic of people going up and down was unique. People were desperate to get in and out. All the casualties I saw exiting the building were with fire fighters.

14.4.94 The statements of Flanagan (in Fire Sector 02:13-02:28, MET00007765, excerpted below) and Eden (in Fire Sector 02:02-02:27, MET00008019, excerpted below) also identify that the speed of the evacuation was reduced due to the number of people within the stair.

> When we went back into the stairwell, the smoke had risen up to the floor at which we were but was thin at this height. It also felt much hotter than it had done before. The further down we went, the hotter it felt and the smokier it became. Going down, I found that I was able to see a small amount and could make out other firefighters and see was what happening as far as one end of a flight of stairs to the other. The stairs were full of firefighters and became clogged with people. There were firefighters coming up whilst others were going down and some were carrying and dragging out occupants of the tower, coming out at various different floors. Where this was happening, it slowed down everyone's descent of the stairs and when we got to about the twelfth (12th) floor, it came to a complete standstill. There were firefighters behind us also stuck and I could hear the low pressure whistles on the sets of some of those behinds us going off. The low pressure whistle means that there is on three (3) to four (4) minutes worth of air left in that persons set. I shouted down the stairs that there were people running out of air to try and get people moving down the stairs and after a brief delay we got moving down again.

14.4.95 Eden (in Fire Sector 02:02-02:27, MET00008019) stated:

said no. I told him that I was just in front of him and he said that he was going to come past me. This isn't really the correct thing to do as I was BA number 1, however as we were only traversing the stairwell and he is bigger and taller than me, I was fine with it as I was carrying most of the gear and he could clear the way a little bit. Bottlenecking was obviously going on which is where people had to wait on the stairs whilst others went in through doors, due to the small stairwell and being unable to get past each other. We

14.4.96 O'Neill (Arrived at site approx. 02:12, MET00010758, excerpted below) specifically noted that the stair did not permit 2 firefighters to walk side by side.

Our efforts throughout were hampered by the size of the stairwell which was surprisingly small. It was so narrow that 2 firefighters in BA could not walk side by side. Unfortunately there were also a number deceased persons in the stairwell which made it difficult to negotiate.

14.4.97 The statement of Fernandes (in Fire Sector 02:01-02:27, MET000083292, excerpted below) identifies that the stair was narrow.

"Both Firefighter WILLIAMS and I made our way towards the staircase of the tower. The staircase was painted yellow or magnolia, it was very narrow. It was tight climbing the stairs with the equipment we were carrying."

14.4.98 The statement of Graham (arrived at site approx. 07:55, MET00005257, excerpted below) identifies that the stair provided to Grenfell Tower restricted the number of firefighters that could be safely deployed within the building.

The single staircase added addition restrictions on how many people you could safely commit to fight the fire. The dry riser inlet placement at the far side of each lobby meant you had to fight your passed the fire flats to reach it,

The addition of casualties blocking the stairs from the 9th floor up was an added obstacle that we could only rectify once we had extinguished those floors sufficiently to assure that we could respectfully place the deceased into the fire lobbies on those floors without the fear that they would then be compromised due to fire spread.

14.4.99 My conclusions, therefore, with regard to the width of the stair are as follows:

a) There is evidence that firefighters arriving and entering the building from approximately 02:00 described the stair as being narrow and difficult when they needed to pass each other.

b) There is specific evidence that the width of the stairs, combined with poor visibility and obstacles later on in the fire caused by casualties and debris, made the stairs difficult to traverse.

c) Four fatalities were found on the stair (refer to Section 20 of my report).

d) It was specifically noted as being difficult for firefighters wearing BA to navigate the stairs as there was not enough room for them to turn sideways to make space for others to pass.

14.4.100 I provide my calculation of the stair capacity in Section 16 of my report, and I address the issue of stair width for evacuation in Section 19 of my report.

14.4.101 Descriptions of Firefighters unable to find floor numbers

14.4.102 The following excerpts identify specific examples of firefighters having difficulty tracking their location within the building.

14.4.103 The statements identify that this was due to the presence of smoke in the stairs affecting visibility, but also depositing soot on the floor number signs provided in Grenfell Tower.

14.4.104 Fernandes states (MET000083292):

"As I climbed up the stairs the smoke became thicker and in between floors two and five the lights went out. As the smoke became thicker visibility was reduced to almost zero. Firefighter WILLIAMS and I had to stay in physical contact with each other as we climbed the stairs. I struggled to see any reference to what floor we were on. There were lights on the floor numbers, however I could not see the number displayed. We were both working hard climbing the stairs with the equipment. My torch developed an intermittent fault, it started to fail. I lost track of how many floors we had climbed, I shouted to Firefighter WILLIAMS to enter the next floor area to find out what floor we were on. We went through the next door to the right. The smoke was thick and visibility was almost zero. Looking extremely closely at the walls I found a sign that displayed "14". I realised we were six floors short of where we needed to be."

14.4.105 Hoare stated (MET00008027):

"I remember the 5th floor being clear but by floor 7 we could see very little or nothing at all. I had to clean out my visor to make out the floor number.
...
By floor 9, I had to wipe soot off of the walls to see what number of floor we were on."

14.4.106 Upton stated (MET00007524):

> It was really hard work. Our BA sets were especially heavy as they have the twin cylinders, and Tom was also carrying the enforcer. It was hot and dark. At a certain point we decided to check how far we had got. I eventually found a door which led into the lobby area. The conditions in the lobby were similar to those in the stairwell. I couldn't see any actual flames but there was thick, heavy, dense smoke and it was really hot. I had to search around the corner to find a door with a flat number on it. I couldn't work out what floor we were on, but I knew that the flat number was nowhere near the ones we were trying to get to. I think we were about half way.
>
> We decided to check our progress again so went into another lobby area and found another flat number. We couldn't see so we had to get right up close to the door to shine our torches on it. The one we found was something like Flat 164, so I knew we still had a way to go. I estimated we were on about the sixteenth floor. The conditions were similar to the stairwell but it was getting hotter as we went up the building.

14.4.107 Flanagan stated (MET00007765):

> I lost track of exactly what floor we were on as we were going up but when we got to about the fifteenth (15th) floor the smoke suddenly cleared. It was like a light had just been switched on. I could see clearly again and there was no smoke at all. I thought we must be climbing up the stairs faster than the smoke was rising. I could now see the floor numbers again so me and Luke decided to run the last few flights of

14.4.108 Eden stated (MET00008019):

> stairs. We didn't have to wait too long before we started moving again. It was really tight in the stairwell and it was full of thick black smoke and we had to lean on the wall to take a reference point. I couldn't see Tom in front of me, even though he was right there with reflector straps on and I had to keep touching and banging him to let him know I was there. I heard someone say, "This is the 10th floor" and "Oh good, only 2 more to go". Tom and I were still checking with each other that we were alright and how much air we had used and at this point, I think that I had used 50 bar.
>
> I asked Tom if he could see any numbers as it felt like we had been walking in the dark, blind and not knowing where we were and he said that he couldn't see anything. We continued up and I heard the EDBA team in front say, "We're going to 12 - this is us". We waited for about 30 seconds for them clear

14.4.109 Batcheldor stated (MET00007511):

> smoke. Firefighter carry a waterproof pencil called a Chinagraph which had been used to mark the floor numbers on the wall from other firefighters. If it wasn't for these Chinagraph markings you would not have known what floor you were on. We finally reached the 10th floor. Myself and Neil were the only

14.4.110 **Performance of the protected stair**

14.4.111 In Section 13 I calculated the flow rate of evacuating residents with time based on the data provided by the MPS using CCTV footage of residents leaving the building (MET000016072). Using the evidence, I have collected from the firefighter witness statements and LFB command logs, I have categorised the condition of the stair using the criteria defined in Table 14.6 below.

Table 14.6 Criteria corresponding to the condition of the stair using firefighter witness statements

Condition report	Description of condition noted within witness evidence
Conditions clear	No evidence of smoke or fire. E.g.: *"there was no smoke alarm, no smoke and it was light"* (Alves, IWS00000538).
Limited smoke observed	Small quantity of smoke in the form of either a thin layer of or diffuse, light coloured smoke – breathable. E.g.: *"only a thin layer of smoke on the ceiling of the stairs… I was able to start breathing properly"* (Khalloud, IWS00000473).
Significant smoke observed	Smoke is observed to fully fill the space and impede vision but is still light in colour, with visibility still adequate for movement throughout. E.g.: *"we were engulfed but it was still possible to see … surrounded by a thick grey mist"* (Kassemdjian, IWS00000951).
Thick smoke observed	Smoke is thick black smoke, fully fills the space and visibility reduced to zero or close to zero. Not breathable and presenting a high risk to life. E.g.: *"completely pitch black – it's irrespirable, so you're coughing, choking … as soon as you're not touching a wall or door you don't know where you are"* (firefighter Dorgu transcript).
Substantial heat noted + + + +	Attached to any specific mention of the conditions being hot or the temperature being high. E.g.: *"it was really hot"* (firefighter Upton, MET00007524).
Area inaccessible	This area is specifically noted in firefighter witness statements as not reachable by firefighters at a specific time for one or more of the following reasons: Conditions of heat in the stair; Conditions of fire in the building; Obstacles impeding firefighter progress; or Water supplies not sufficient to permit safe progress for firefighters onto the floor. E.g.: *"I pulled the door towards me to open it and the heat was incredible. … When the heat hit us and it felt just like opening an oven door."* (firefighter Hoare, MET00008027).

14.4.112 I have illustrated the condition of the stair and lobbies based on the witness evidence from both residents and firefighters as provided in Appendix N, as well as evacuation statistics from CCTV footage, BA telemetry and details of FSG calls.

14.4.113 Figure 17 to Figure 30 use section drawings of Grenfell Tower (SEA00009461) and present information from the time of the first escaping resident at approximately 00:58 until 08:20 in the morning of 14th June.

14.4.114 I have used this data to understand at what point conditions in the stair would be likely to impact the ability of residents to escape safely. I want to compare this with evidence provided from firefighters and residents regarding their observations of the conditions in the stairs with respect to presence of smoke and heat.

14.4.115 I also use this data to compare the progress of the evacuation down and the access up the stairs, with the external conditions from the cladding.

14.4.116 The analysis below is to allow me to understand in more depth how the stairs were used at critical time slots. In particular, I am interested in the first 40 minutes; then the time from 01:40 to 02:35 at which point guidance changed regarding Stay Put; and then what happened after that time for residents who were still present in the Grenfell Tower.

14.4.117 The times at which residents were able to escape provides evidence that conditions in the stair were sufficiently tenable to permit unprotected persons to use them, even though they may have been affected or even severely affected by smoke and heat in their journey down the stairs.

14.4.118 I have compared this with the firefighter movements, noting they were wearing protective clothing and breathing apparatus.

14.4.119 Each of the diagrams:

a) Covers a specific time period, marked at the top of the diagram and in the caption.

b) Uses a small eye icon to identify the specific floors on which direct witness observations are available to me, within the relevant time period. The area remains displaying the same condition as was last reported until a further update is given. Individual eye icons are provided to each lobby on which observations were reported. For observations from multiple floors within the stair, a single eye icon with an associated blue column are provided to demonstrate the group of floors to which the witness statements refer (refer to Figure 14.18 for example).

c) Identifies the number of occupants escaping from each floor within the relevant time period. This is important to understand i.e. which stair doors will have been opening to permit escape, relative to the smoke conditions in the lobby on each floor. Albeit temporarily. But also if the stair case was being used by any residents for escape at that time, and from which floors.

d) Shows a photograph of the progress of the fire on the external wall at that time period.

e) Identifies the number of firefighters in breathing apparatus that were active beyond the bridgehead. This is important to understand the resources available to undertake firefighting and search and rescue operations at any point in time, as well as providing an indication of how

many stair doors may have been opened into lobbies affected by smoke to permit firefighters to enter.

f) Identifies the floors on which significant smoke staining and apparent heat damage were observed in the stairs in my post-fire inspection between the 7th and 9th November 2017.

14.4.120 Please refer to Appendix N for a full list of all evidence that has been used to compile these diagrams, noting all entries are presented in chronological order.

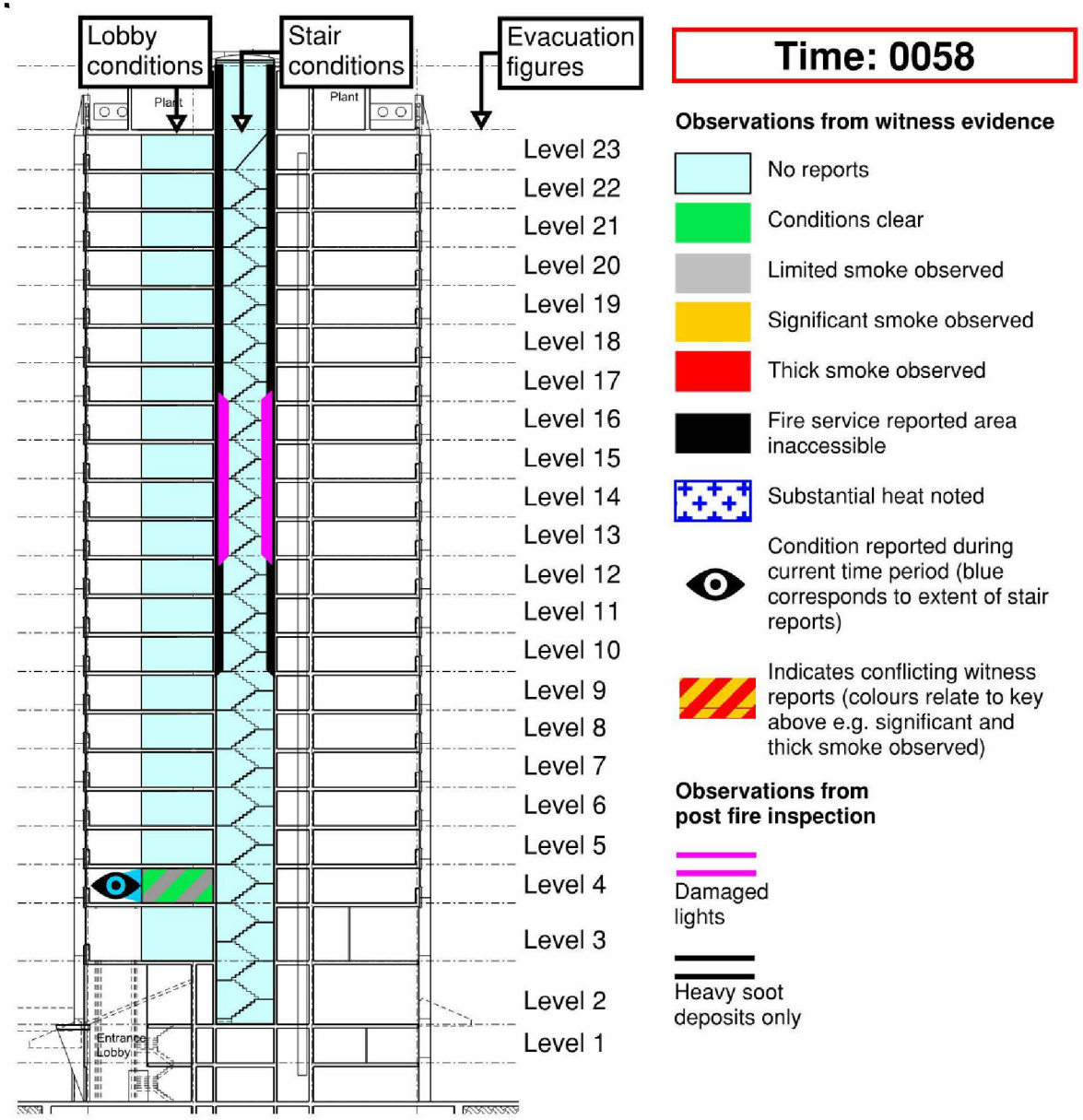


Figure 14.17 Condition of the stair and lobbies at 00:58

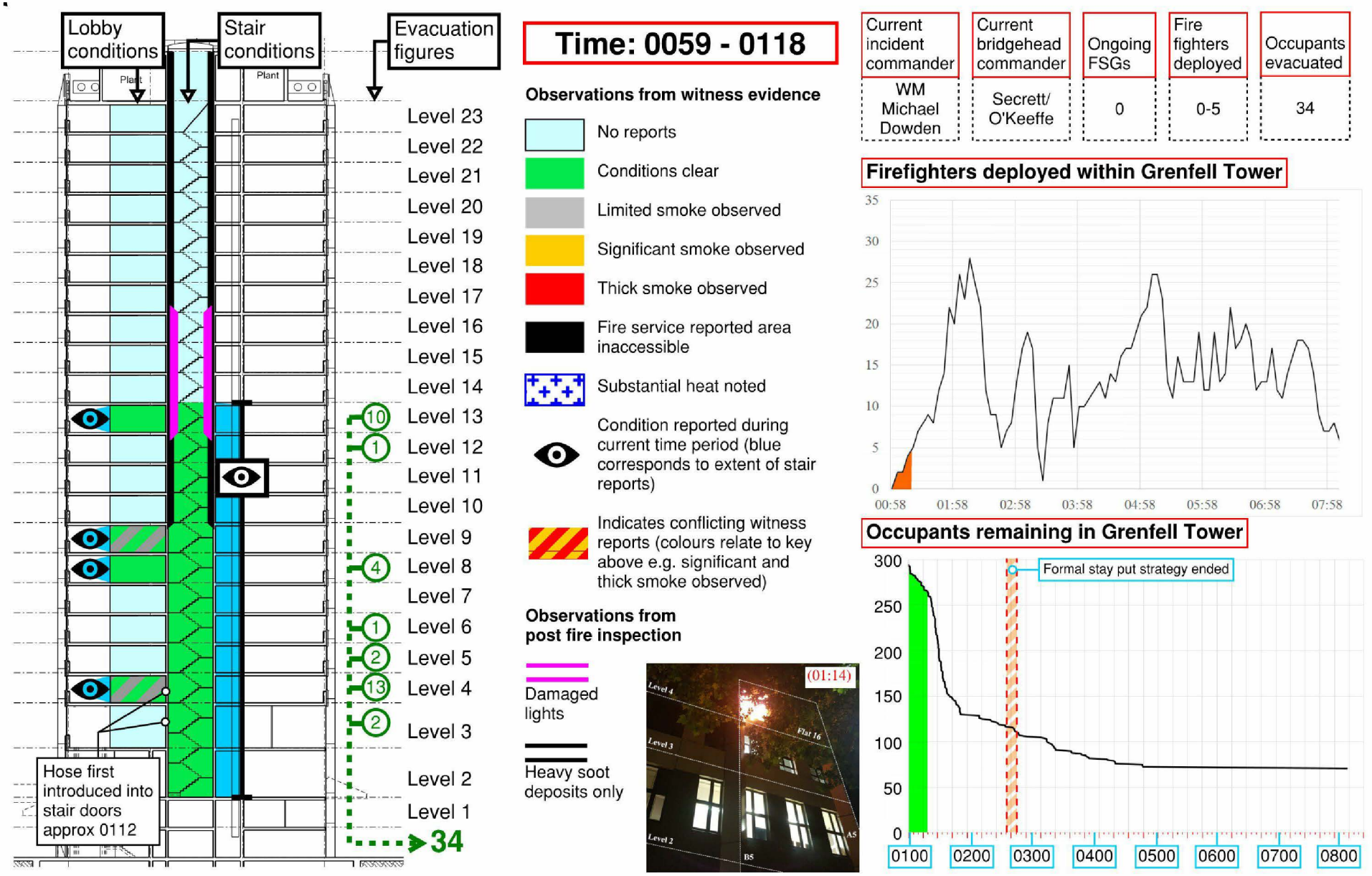


Figure 14.18 Condition of the stair and lobbies between 00:58 and 01:18

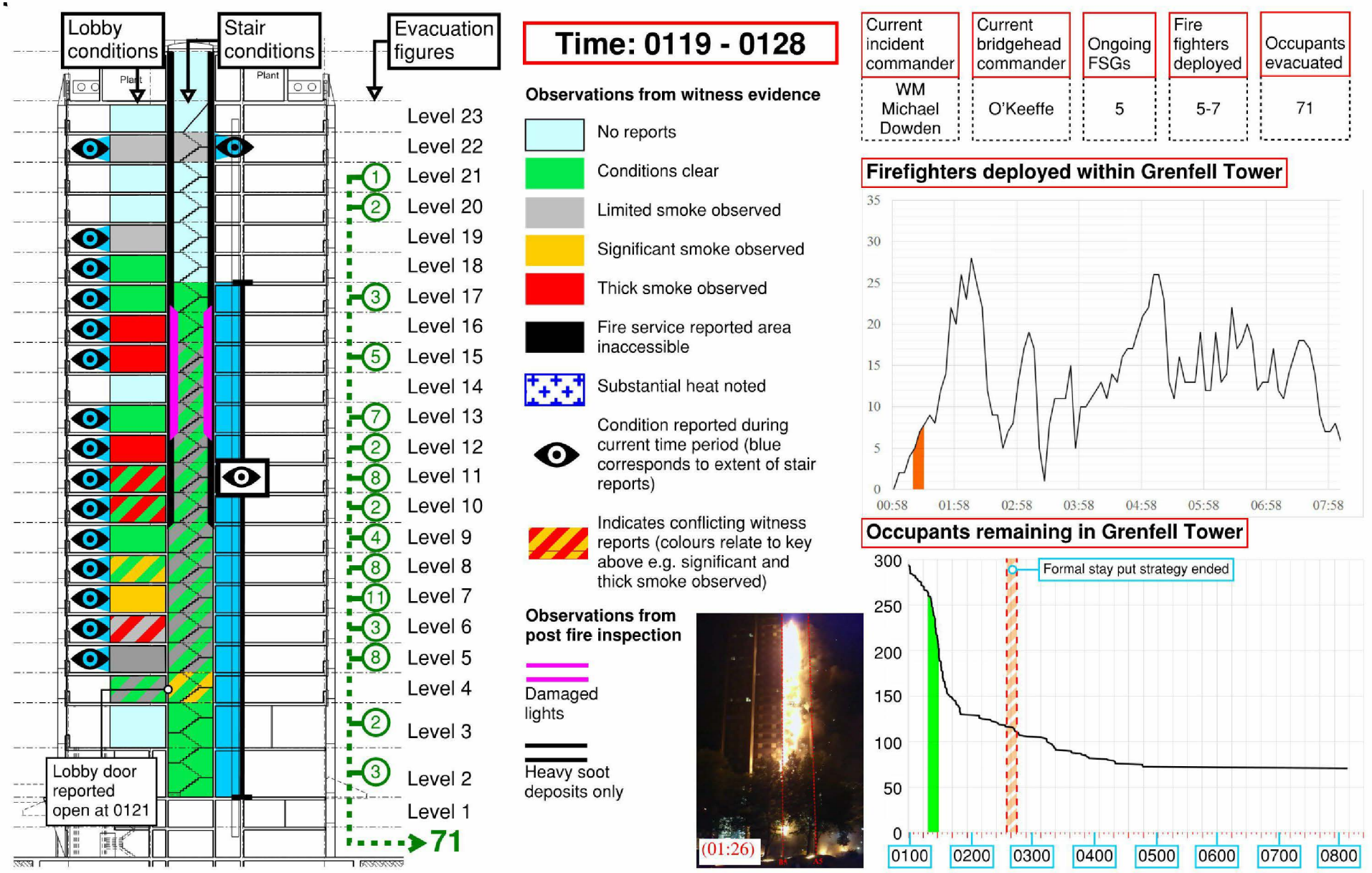


Figure 14.19: Condition of the stair and lobbies between 01:19 and 01:28

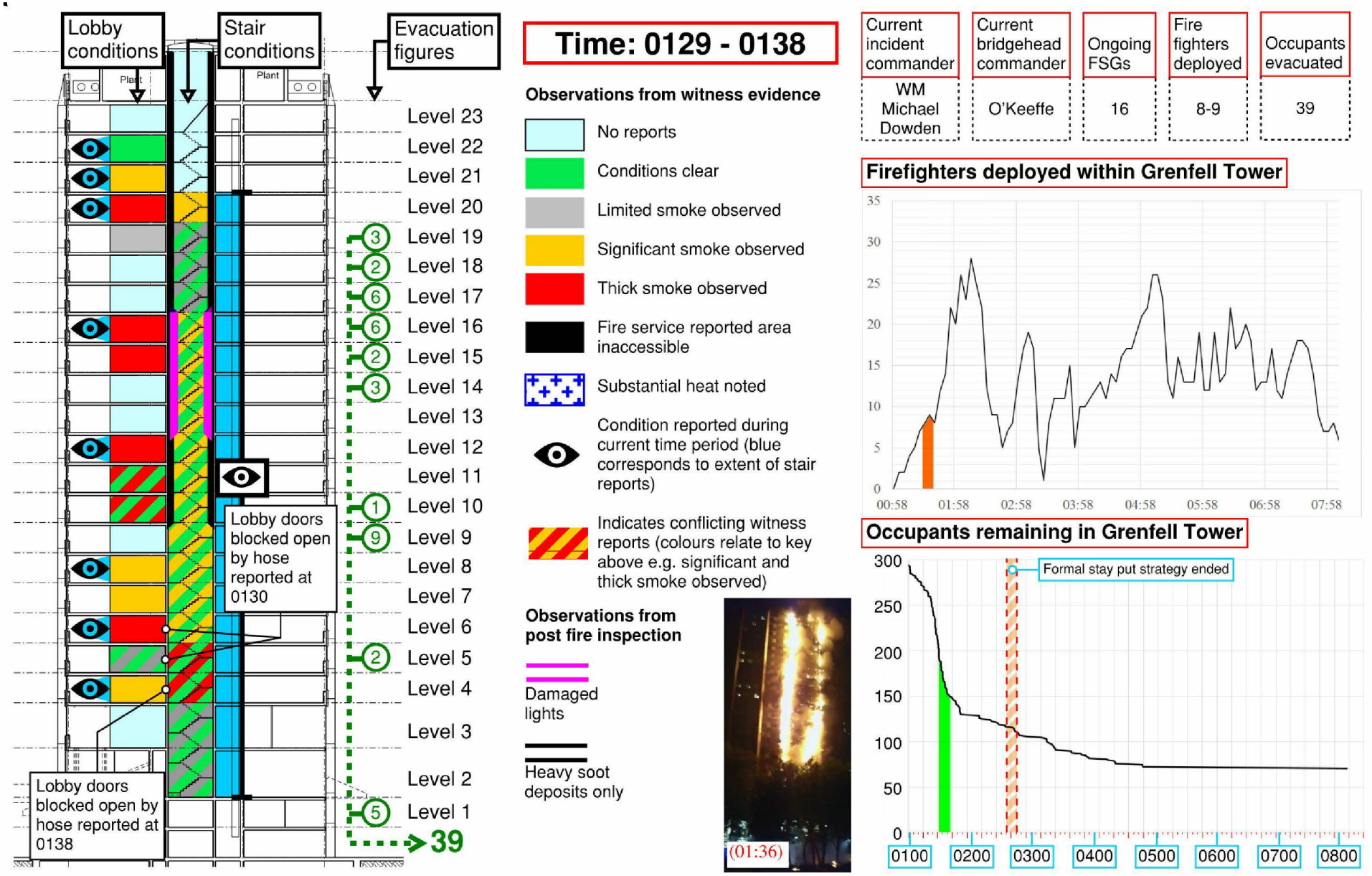


Figure 14.20: Condition of the stair and lobbies between 01:29 and 01:38

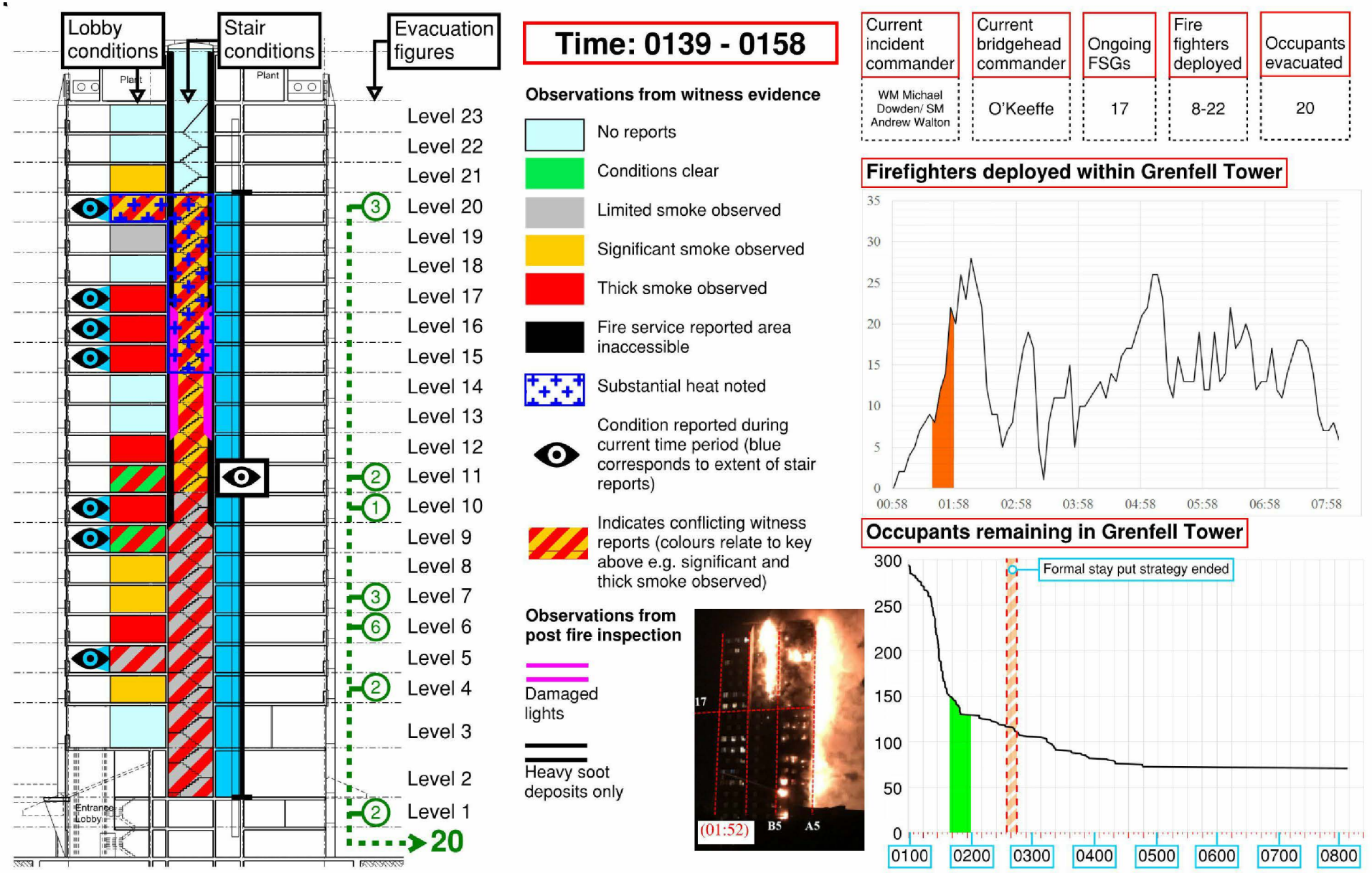


Figure 14.21: Condition of the stair and lobbies between 01:39 and 01:58

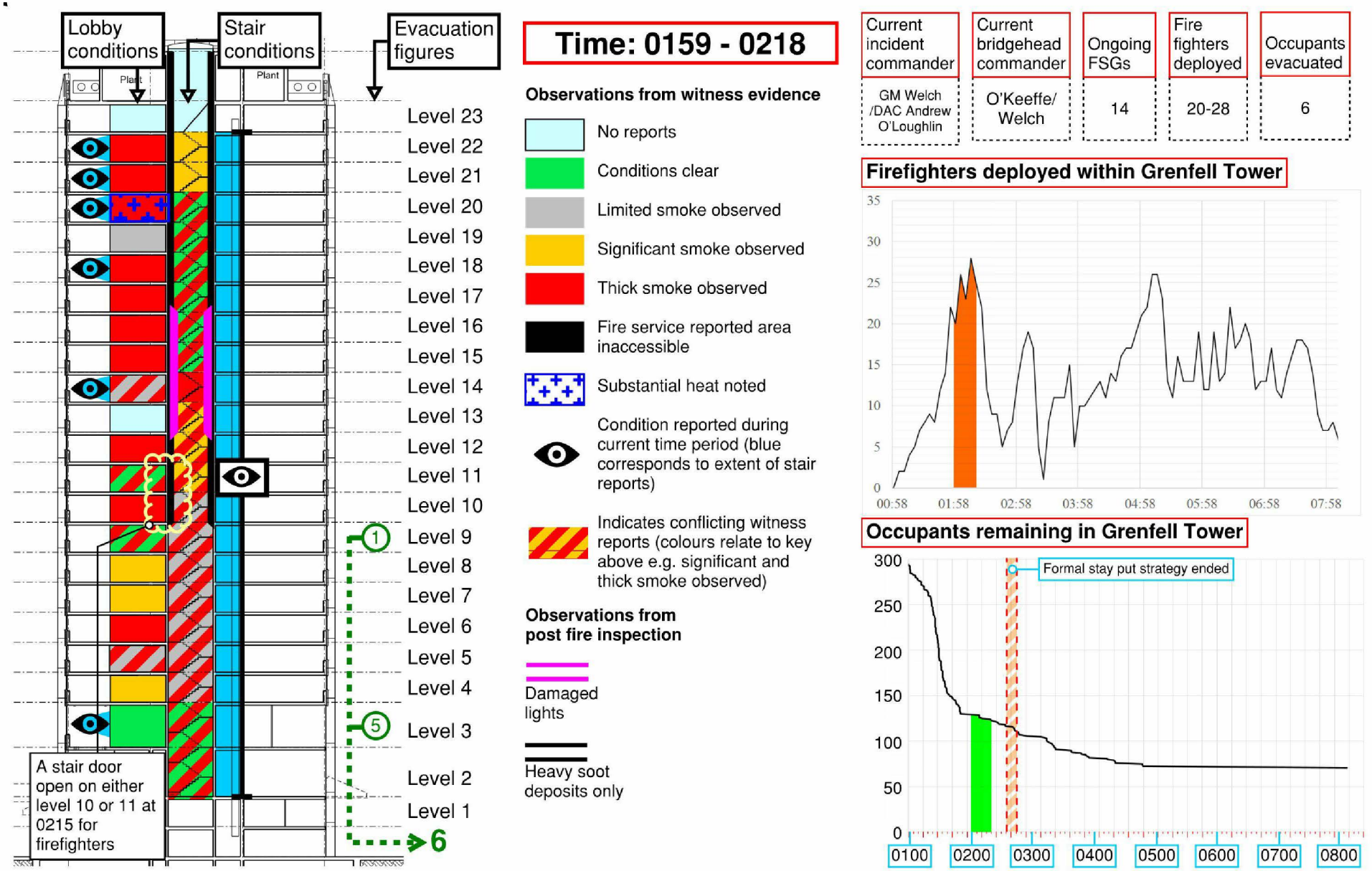


Figure 14.22: Condition of the stair and lobbies between 01:59 and 02:18

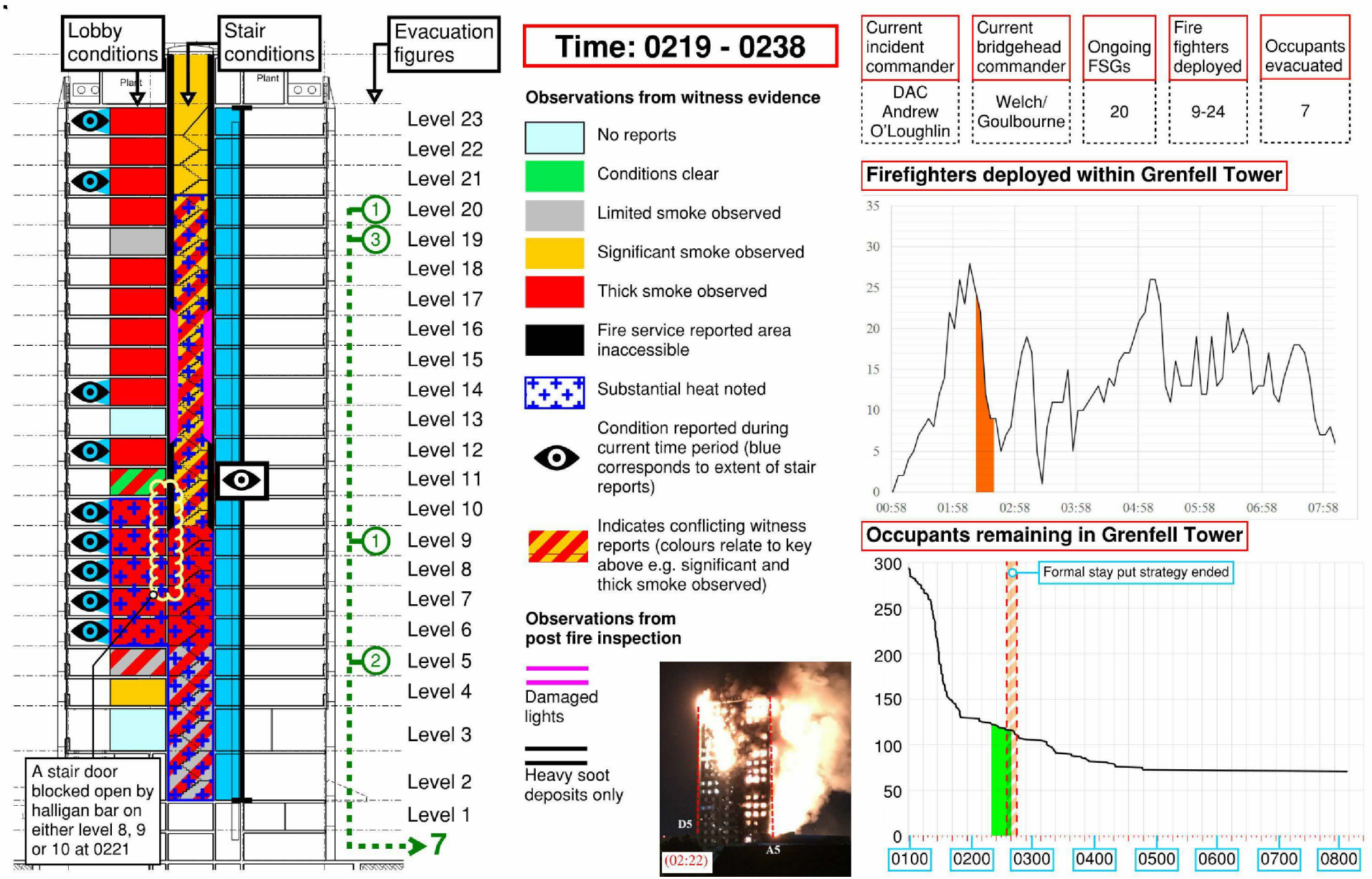


Figure 14.23: Condition of the stair and lobbies between 02:19 and 02:38

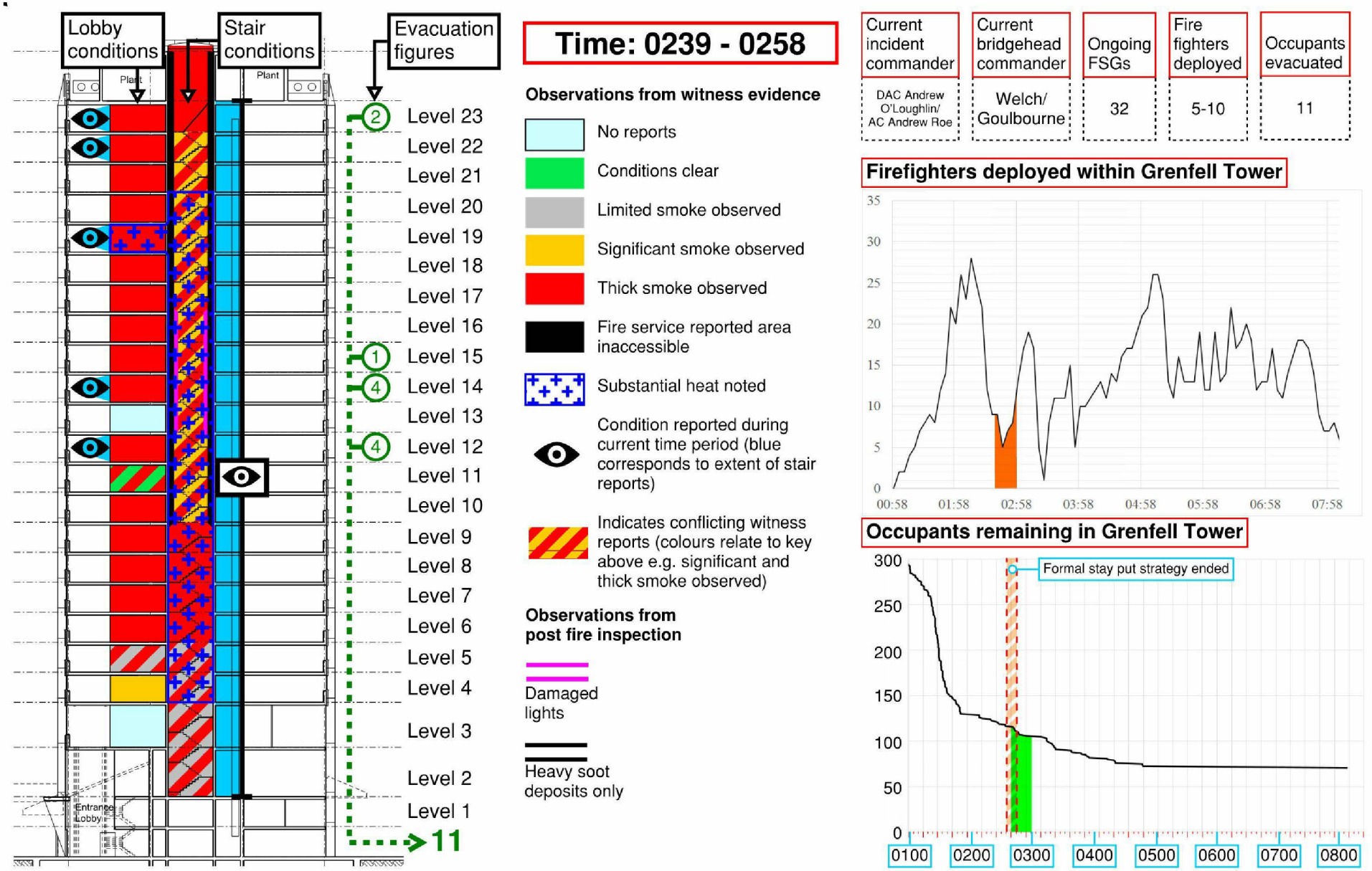


Figure 14.24: Condition of the stair and lobbies between 02:39 and 02:58

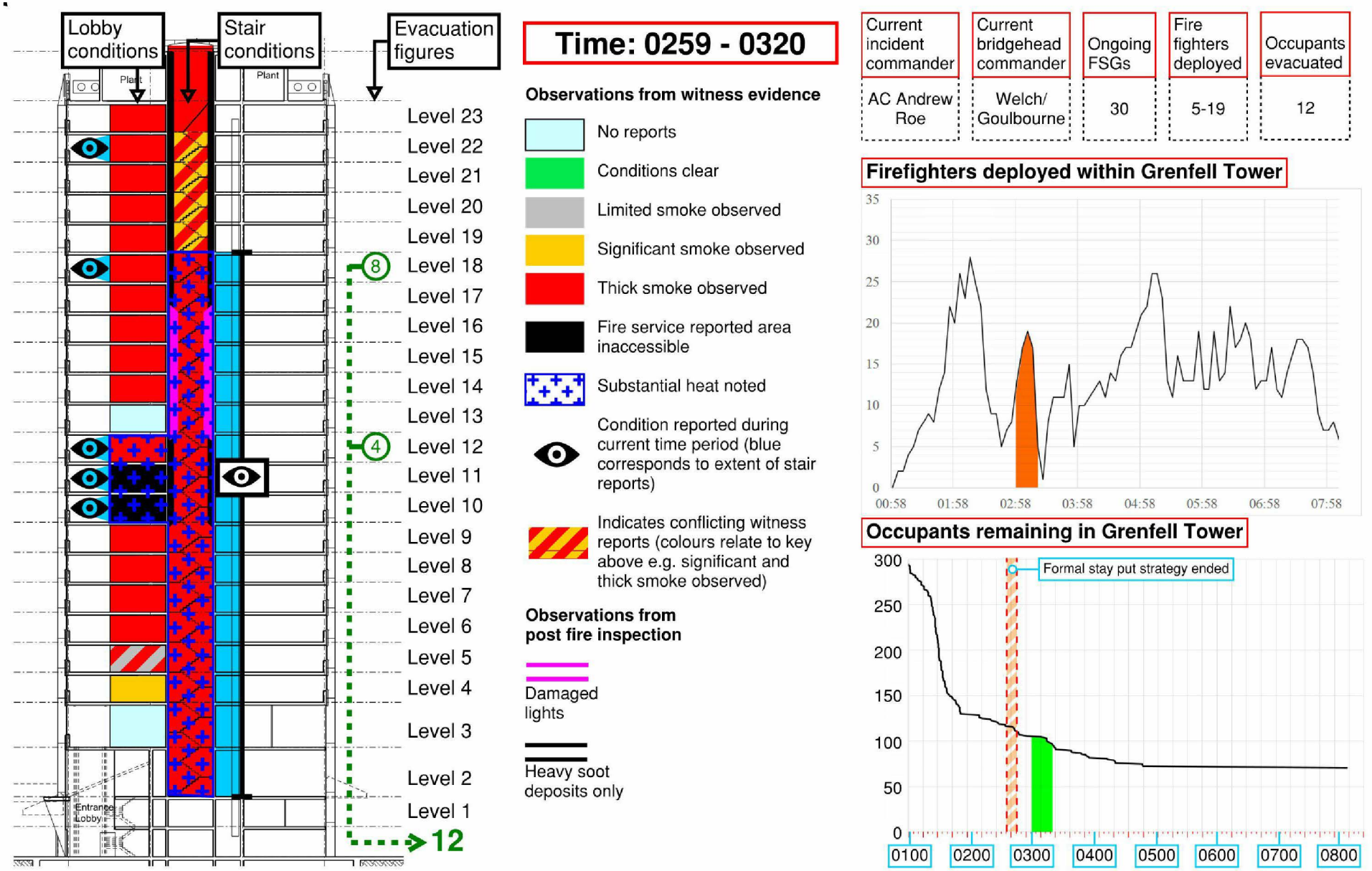


Figure 14.25: Condition of the stair and lobbies between 02:59 and 03:20

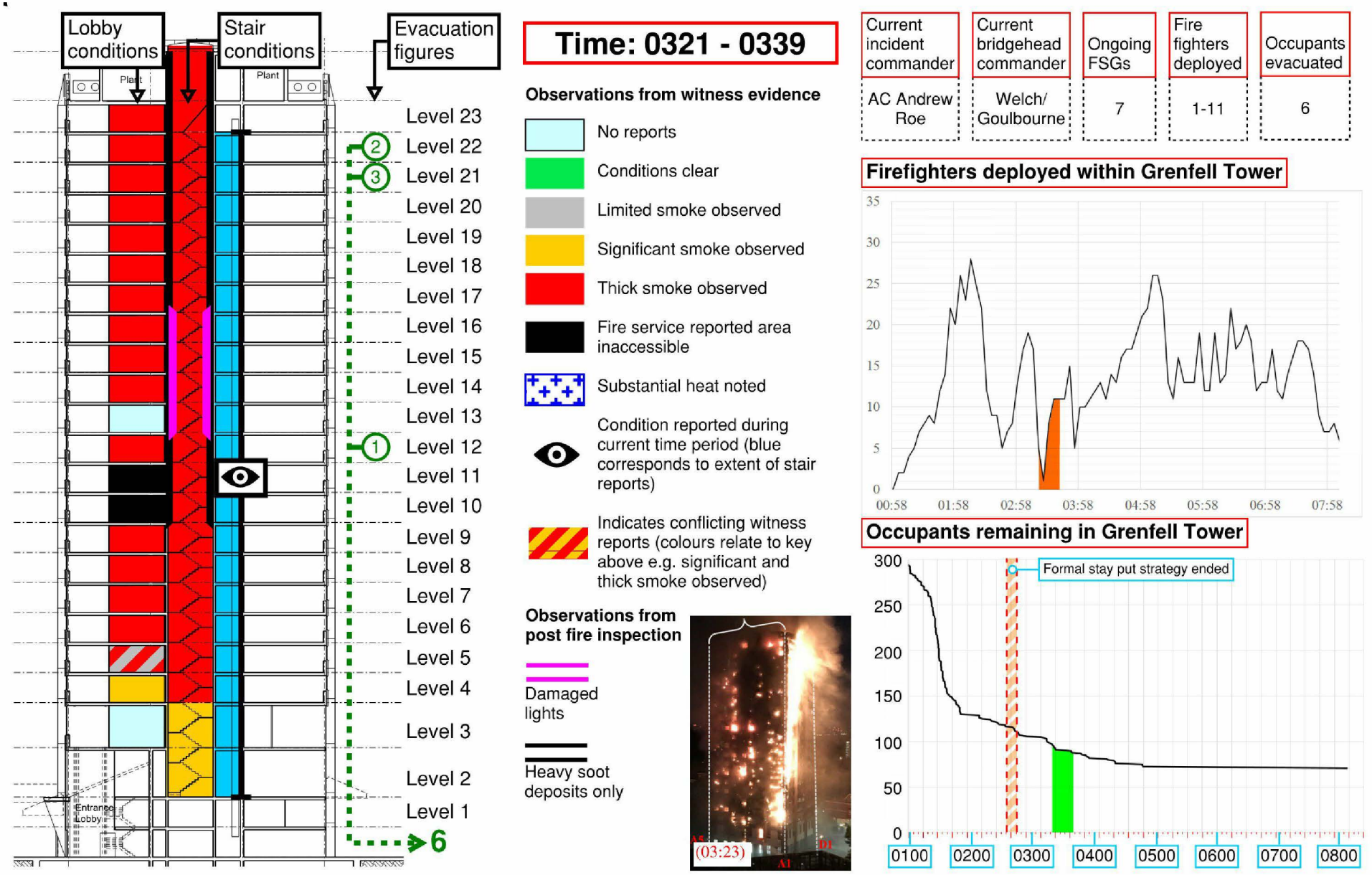


Figure 14.26: Condition of the stair and lobbies between 03:21 and 03:39

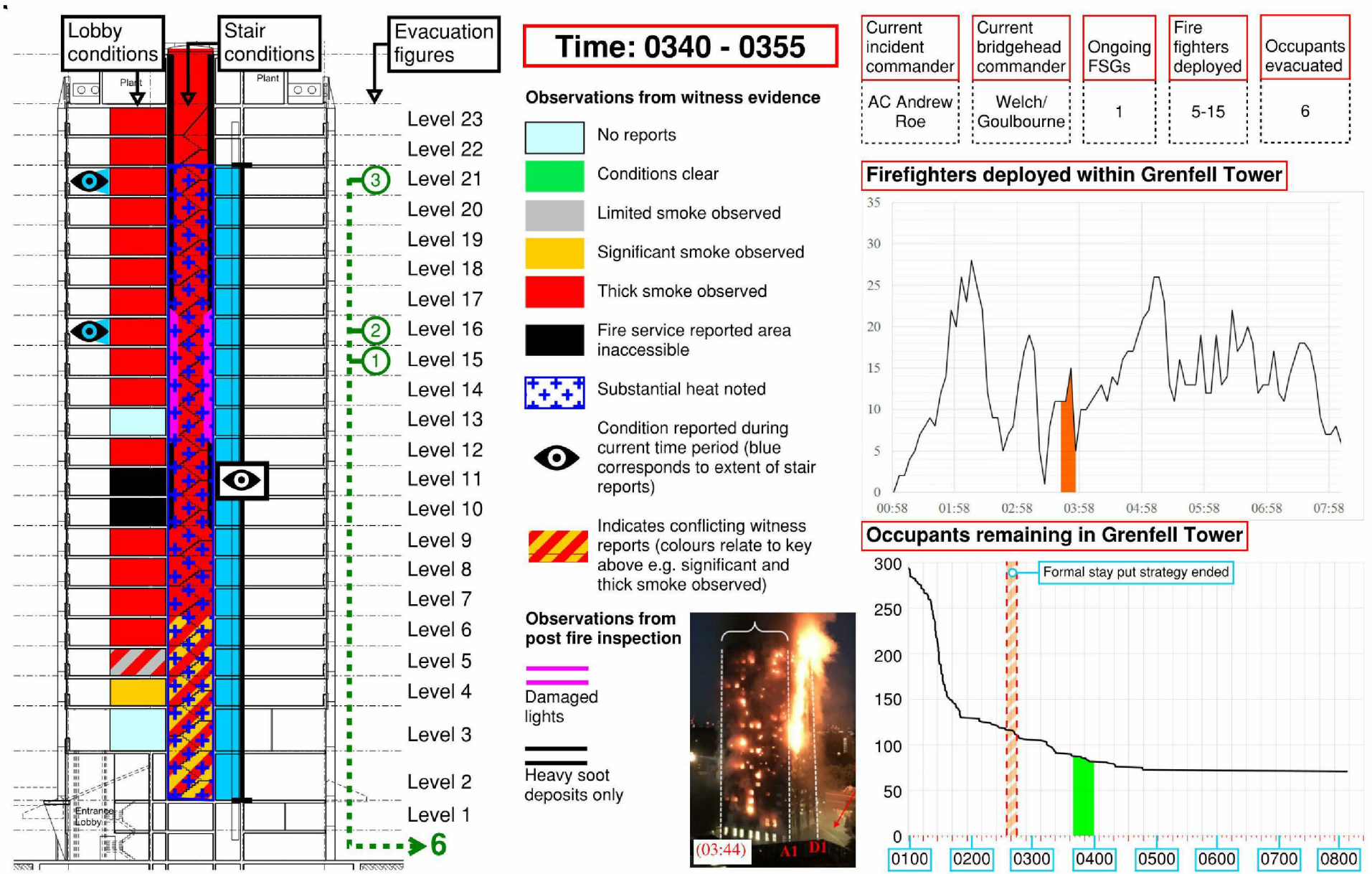


Figure 14.27: Condition of the stair and lobbies between 03:40 and 03:55

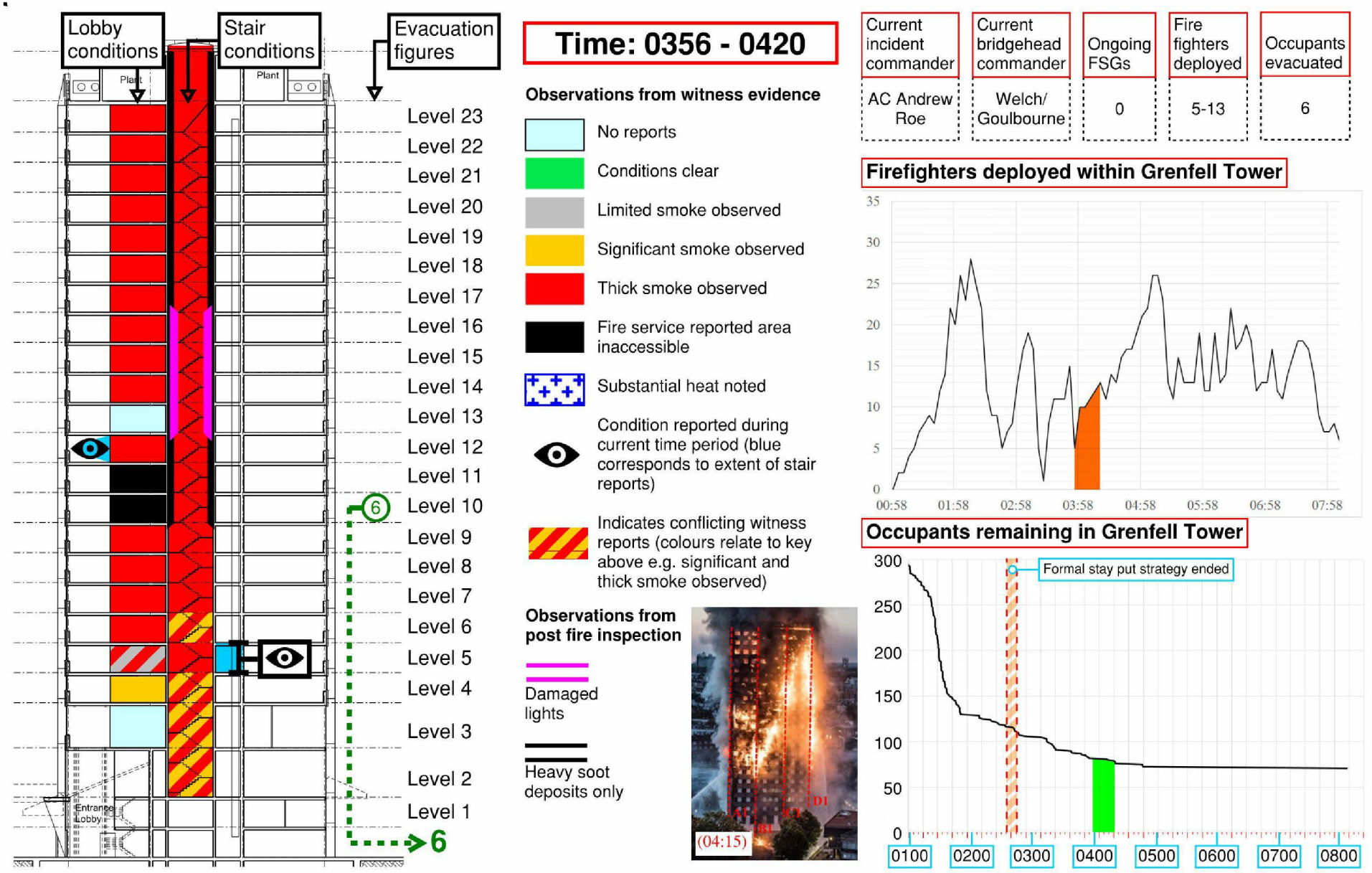


Figure 14.28: Condition of the stair and lobbies between 03:56 and 04:20

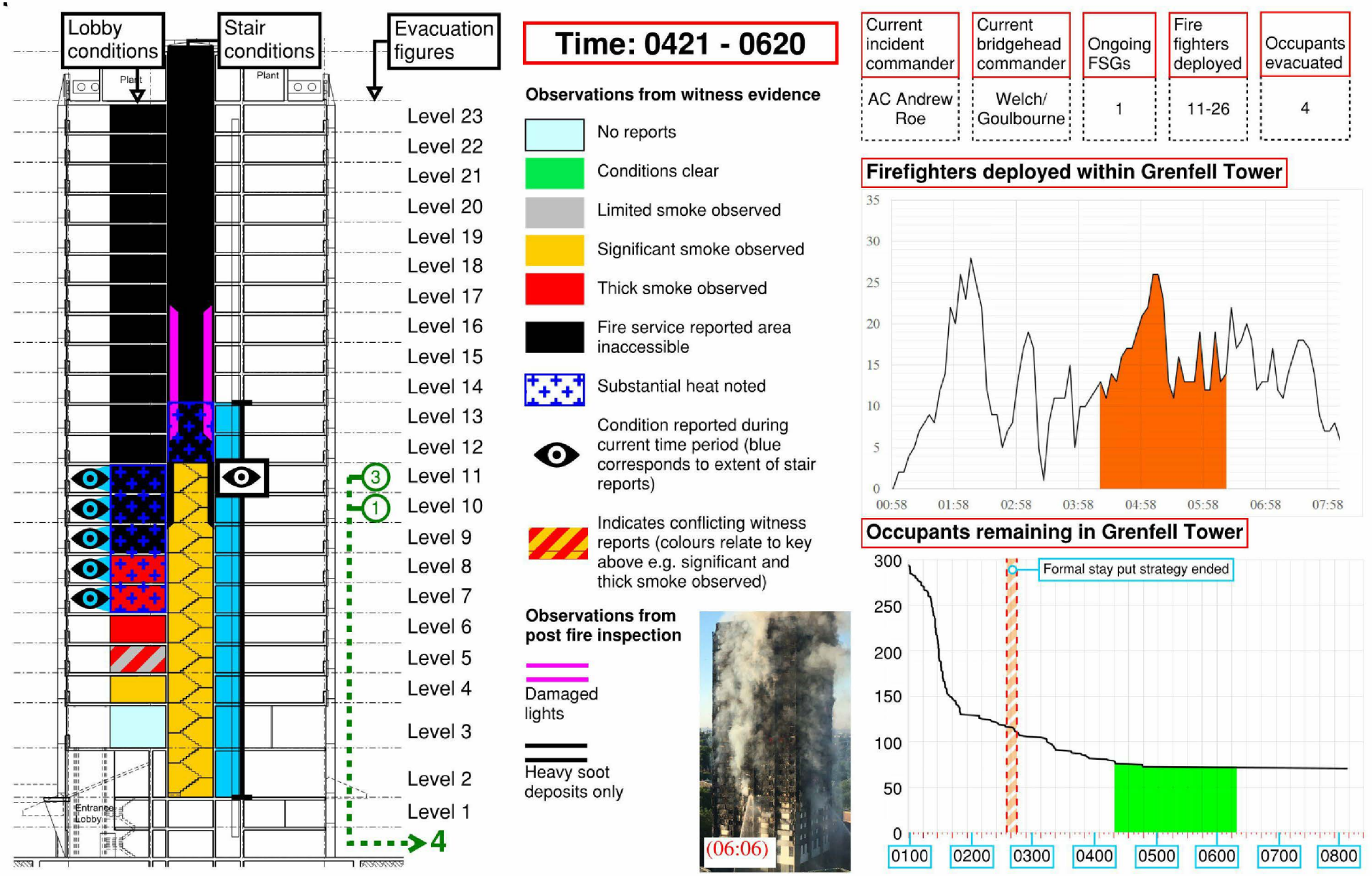


Figure 14.29: Condition of the stair and lobbies between 04:21 and 06:20

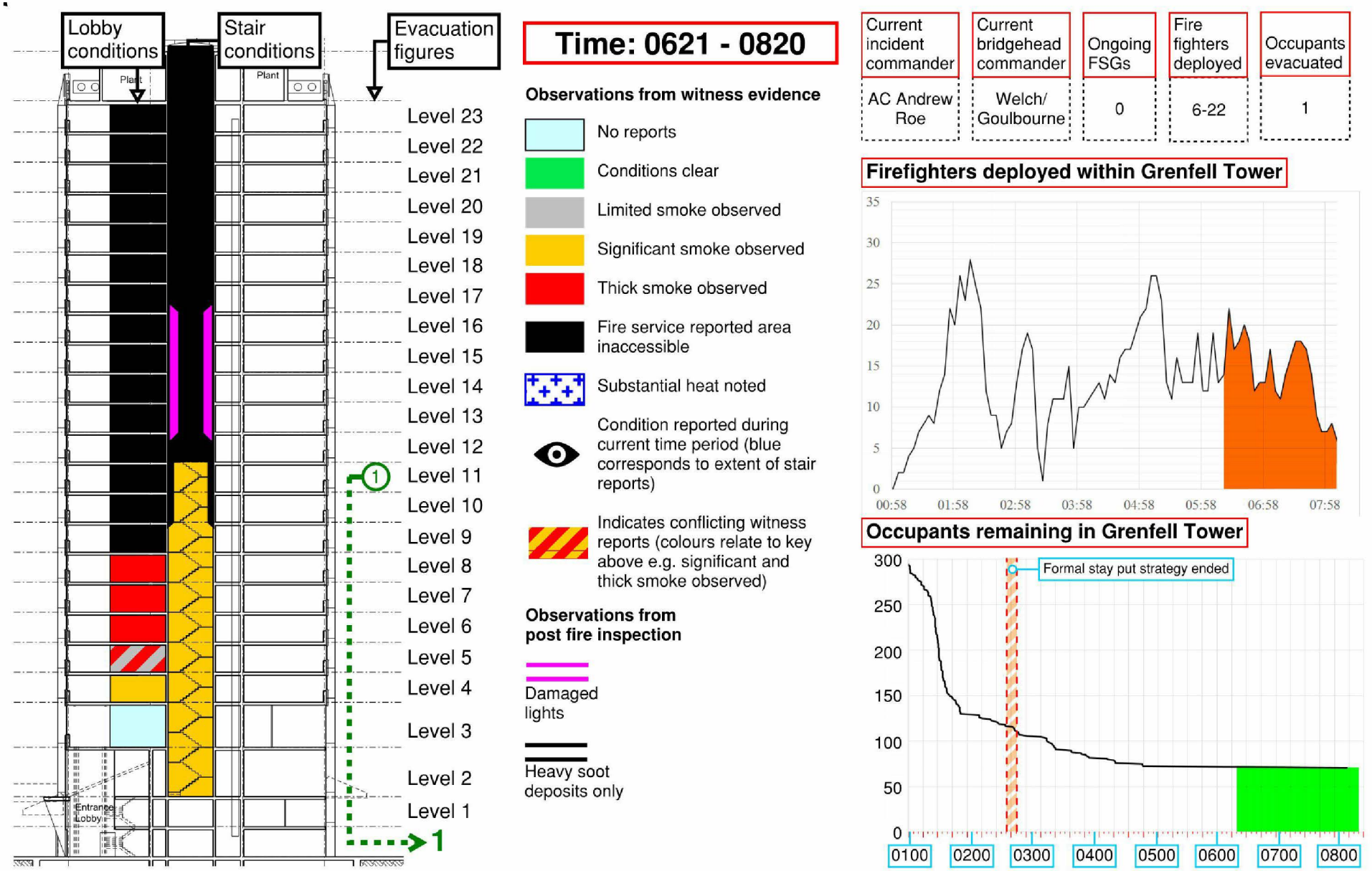


Figure 14.30: Condition of the stair and lobbies between 06:21 and 08:20

14.4.121 Position of the Bridgehead relative to conditions of the stair

14.4.122 The Bridgehead, the forward control point for firefighting, and for search and rescue operations in a building, is required to be located in a safe air environment below the level of the fire. The condition of the stair is therefore relevant to the position of the Bridgehead. Please refer to Section 19 of my report, and Appendix H for more details of the Bridgehead and how it is defined and used as part of current firefighting tactics.

14.4.123 In Section 13 Critical Times, I referred to the position of the Bridgehead over the course of 14th June 2017. I set out the evidence for these positions below.

14.4.124 Between 00:58 and 2:00 the Bridgehead was located at Level 2. Level 4 was the fire floor at 00:58 therefore the Bridgehead was 2 floors below the fire floor (Brown, MET00005251, excerpted below). Level 04 remained the lowest fire floor during this time. This is in accordance with the recommended firefighting tactics for high rise buildings described in Section 19.

> I was concerned the lift may not move as it looked as though it may be overloaded, however, CM Batterbee, CM Secrett, FF De St Aubin, FF Badillo and I together with many items of equipment loaded into the lift began making our way to the second floor, two floors below the fire floor to create a bridgehead. From information already gathered upon arrival and communicated via hand held radio we had confirmation the fire was indeed in flat 16 located on the fourth floor.

14.4.125 At approximately 02:17 it was moved to Level 3 (Cook, Transcript 24th July 2018, p197)

> Q. Right.
> Does that mean you weren't involved with the actual move from the second to the third floor?
> **A. Not that I can recall. I just recall vividly that we were on the third when I came back.**
> Q. Now, can you help us with the timing of the move from the second to the third floor? How soon after your taking these photographs at 02.15, 02.17, did you come
>
> Page 197
>
> back into the building and find that it had been moved to the third floor?
> **A. It would've been straight away, so -- yeah.**
> Q. Right, okay, that's helpful.

14.4.126 Evidence of movement of Bridgehead to Level 3 from Welch (MET00007525):

> The Bridgehead was held by two (2) Watch Managers – one of whom I now know was Brian O'KEEFE– who had done a fantastic job but I told them that our BA crews would never make the 24th floor from where we were so we needed to move the Bridgehead up. I asked a BA crew who had just came out to draw a floor plan on the wall of the mezzanine to show incoming crews what they would be faced with. Then I went to the 3rd floor, checked it was safe and decided to move the Bridgehead up there. I was happy that any BA crews already deployed from the mezzanine would have to pass us on their way back

14.4.127 At approximately 03:08 Cook records (MET00015779) that the Bridgehead was moved down to ground floor.

14.4.128 Goulbourne (MET00010759) records the bridgehead was moved because the Bridgehead on the 3rd floor was compromised by smoke. Note that the exact reasons for moving the bridgehead will be investigated by other experts as part of Phase 2.

> hold this was not possible. All the while there were FSG's coming in reporting persons trapped. We got a crew into one of the lower floors and I think it was the 4 th as well as a call to the flat on the 9th or 11th. The bridgehead was compromised by smoke so we decided to relocate to the lobby.

14.4.129 As presented in Section 14.4.110, smoke was reported in the stair as low as Level 3 by 01:33.

14.4.130 Between 08:30 and 09:00 it was moved to the 4th floor (Cook, transcript 24th July 2017, p234).

> Q. "The water was restored and there was a new Bridgehead command team of Group Managers — John Graham, Julian Spooner and Dan Alie. By this point the time was roughly between 8.30am-9am."

14.4.131 At 13:25 it was moved to the 8th Floor (Ellis, MET00005756).

> **13:25** AC Ellis walk of incident.
>
> Ops Commander GM Rick Ogden confirmed that Hose management on staircase nearly complete.
>
> There is a gas fed fire on the 10th floor.
>
> Floors 5,6,7 and 8 have jets working
>
> Moving the bridgehead to the 8th floor, feel they are making good progress following hose management and changing burst lengths.

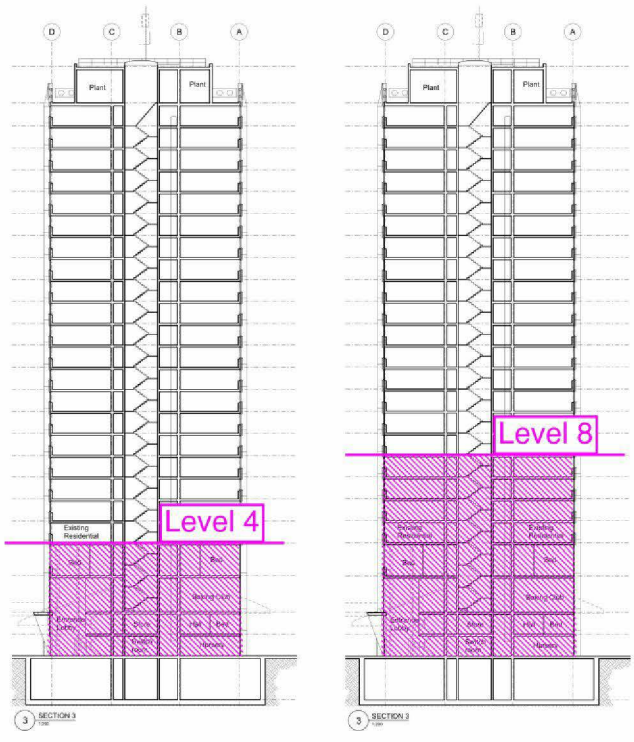
14.4.132 In Figure 14.31 I have overlaid the Bridgehead position over the relevant conditions reported in the stair at these times.

14.4.133 The pink hatching in Figure 14.31 indicates the floors below the Bridgehead - the so-called lobby sector.

Reported at: 00:58

Reported at: 02:17

Reported at: 03:08



Reported at: 08:30-09:00

Reported at: 13:25

Figure 14.31: Location of Bridgehead relative to conditions reported in stairs purple shading indicates the floors below the level of the Bridgehead (SEA00009461).

14.4.134 In accordance with the guidance in the Incident Command manual, the fire sector is defined as the floors involved in fire, plus one floor above and one floor below. In Grenfell Tower, as of approximately 02:15 all floors from the Bridgehead, at this time on Level 03, up to the top of the building were defined by the Incident Commander (O'Loughlin, MET00005213, excerpt below) as the fire sector.

> I assigned GM Richard Welch to take over as Fire Sector from SM Andy Walton and to use the WMs and others already at the bridgehead as support , the Fire sector would be the entire inside of the building from the fire bridgehead to the top.

14.4.135 **Operational limitations on breathing apparatus**

14.4.136 The Fire and Rescue Authorities typically operate 2 types of Breathing apparatus:

a) Standard duration breathing apparatus (SDBA, 30-minute air supply)

b) Extended duration breathing apparatus (EDBA, 45-60-minute air supply)

14.4.137 The duration of air indicated above is an indicative figure. Actual duration of the air supply will depend on breathing rate and exertion of the individual firefighters. Eden (MET00008019) states:

"Compressed air is breathed from the set which has a 300 bar cylinder" ... "Fire Brigade policy states that you must be out of the building with 76 bars of air remaining, plus or minus 5 bar. The warning whistle sounds at 76 bars, which is a safety measure."

14.4.138 Figure 14.31 indicates that firefighters in Grenfell Tower were required to use their breathing apparatus from the Bridgehead. From Figure 14.31 I have shown this was not the standard two floors below the fire floor. In the worst case between 3:08 and 6:31 when the Bridgehead was at ground floor, there were 23 floors between the Bridgehead and the top fire floor (Level 23).

14.4.139 There is evidence of firefighters not complying with operating procedures and exhausting their air supply in attempts to assist casualties (Eden, MET00008019).

"We got to maybe the 16th or 15th floor and did another gauge check. I had about 23- bar left and Tom had about 50. I said to him that we had to go, as we didn't have enough air left to get the man out. Tom said for me to go as he's got enough air

...

Policy says that you go in as a pair and come out as a pair, so I told Tom that he had to come with me, as we had to go. He said that I should go

...

he should have come out with me and I shouldn't have come out without him. I went and stood by the door again to wait for Tom and after about a minute,

he came running out with no facemask on, no helmet and no flash hood. He looked confused, as though he wasn't all there and was coughing and spluttering, not looking very well. He ran straight through the bridgehead, straight down the stairs to the lobby and straight out of the building.

…

I asked Tom where his kit was and he said that he had ran out of air on the 10th or 12th floor and just took everything off and dumped it on the floor."

14.4.140 There is evidence of firefighters leaving residents behind for others to rescue because of breathing apparatus alarms sounding and concerns regarding air running out.

14.4.141 Eden (MET00008019) and Hoare (MET00008027) both reported they had to leave casualties on the way down the stair for other firefighters to bring down because they were running out of air in their BA.

14.4.142 Evidence is also given (Eden, MET00008019) that firefighters were exceeding the normal safety parameters of their air supply leading to alarms (whistles) sounding. The alarms then made operations more difficult by interfering with communication.

"We checked how much air we had left - I had just under 50 bar and Tom said he had 70 and his warning whistle was going off now as well. The whistle goes off at 95 decibels, which causes more agitation - as not only are you running out of air but have a high pitched whining in your ear. We had to really shout at each other to be heard and had a brief discussion about what end (of casualty) *we had."*

14.4.143 On exiting the building breathing apparatus wearers are required to sign in to the BA control officers.

14.4.144 The number of people in the stair and lobbies at one time resulted in queues forming at the exits. This led to firefighters exceeding their normal working air supply while they queued. Eden states:

"There was a queue of fire-fighters at the 5th floor, waiting to exit out on to the 3rd floor." … "loads of whistles were going off and I asked what was going on and was told it was just the queue to get out. I only had 8 bar left, which is only about a minute of air, so asked if I could go in front but was told that everyone was on 10-15 bar, so I just waited."

14.4.145 At 03:08 (Cook, MET00015779) the bridgehead was moved from Level 3 to Ground Floor. At this time all active BA sets were sent an evacuation alarm to bring their users back below the new bridgehead. There is evidence (Hoare, transcript 10th September 2018, p201) that not all firefighters heard this alarm.

and then we both decided -- both our whistles were going. There was also the warning -- the alarm was going off to tell us that we was being evacuated. I didn't hear it going off.

Q. If you can help us with that, the alarm that sounds that the building is going to be evacuated, that's a separate and distinct alarm, is it?

A. That's the ADSU that they can press that sets off your alarm to let you know it's being evacuated, yeah.

14.4.146 In the early stages of the fire, there is evidence (Eden, MET00008019) that firefighters with SDBA sets were being sent further up the building than the EDBA operators. Therefore, the logistical and operational control of the different firefighting teams was a complex issue to address alongside following LFB protocols on health and safety of firefighters. This subject will be covered in more detail by others and I do not consider this any further here.

14.4.147 I raise it here to illustrate the impact the conditions in the stairs had on standard firefighting procedures only.

14.4.148 **Damage to the stairs compared to recorded external firefighting**

14.4.149 As I will discuss in Section 17 and Appendix H of my report, external firefighting operations were conducted on 14th June 2017.

14.4.150 I have compared the approximate reach of the four confirmed sustained external firefighting positions, with the damage to the building envelope observed post-fire on each elevation; refer to Figure 14.32 and Section 17. There appears to be a strong correlation between the levels to which external water was applied and the lack of external fire damage on these levels.

14.4.151 On Figure 14.32 I have also marked Levels 13 – 16, where my post fire inspection has identified the conditions within the stair as being particularly severe. I have overlaid this location to compare it with the extent of external damage and also external fire-fighting water application.

14.4.152 The Level 13 -16 hot zone is primarily above all locations of observed external firefighting water application.

14.4.153 There is an exception on the East elevation where external water was applied up to Level 18 before 02:18. As I describe in Section 17, this appliance had to be relocated due to falling debris. Another aerial appliance (Soho's ALP; N245) was set up on the East elevation by 03:29, however the external firefighting water application from this appliance did not reach the Level 13 – 16 hot zone. Therefore, the overlap of applied external water to the building at

the Levels of the hot zone within the stair, appears to have been primarily in the early stages of the fire.

14.4.154 Current evidence indicates that external firefighting may have prevented or delayed the ignition of internal flat fires on Level 9 and below on the East and South elevations of Grenfell Tower. Therefore, it is possible that external firefighting contributed to relatively better conditions in the stair and lobbies on Level 9 and below, once consistent water application was achieved on those elevations of the Tower.

14.4.155 Finally, I have also over-marked in Figure 14.32, showing the location I believe the last 11 residents to evacuate from Grenfell Tower originated from. This is in Flats 72, 73 and 74 on the South and West elevations of Level 10, and Flats 82 and 83 on the South elevation of Level 11 (MET00016072).

14.4.156 I have described the movement of people within Grenfell Tower in detail in Section 20. However, I have included the movements of these people specifically here, as their ability to evacuate at this late time during the fire can also be considered as evidence that the external fire fighting on the South elevation may have contributed to limiting the fire spread below Level 11, and so contributed to those flats remaining a relatively safe zone until that time.

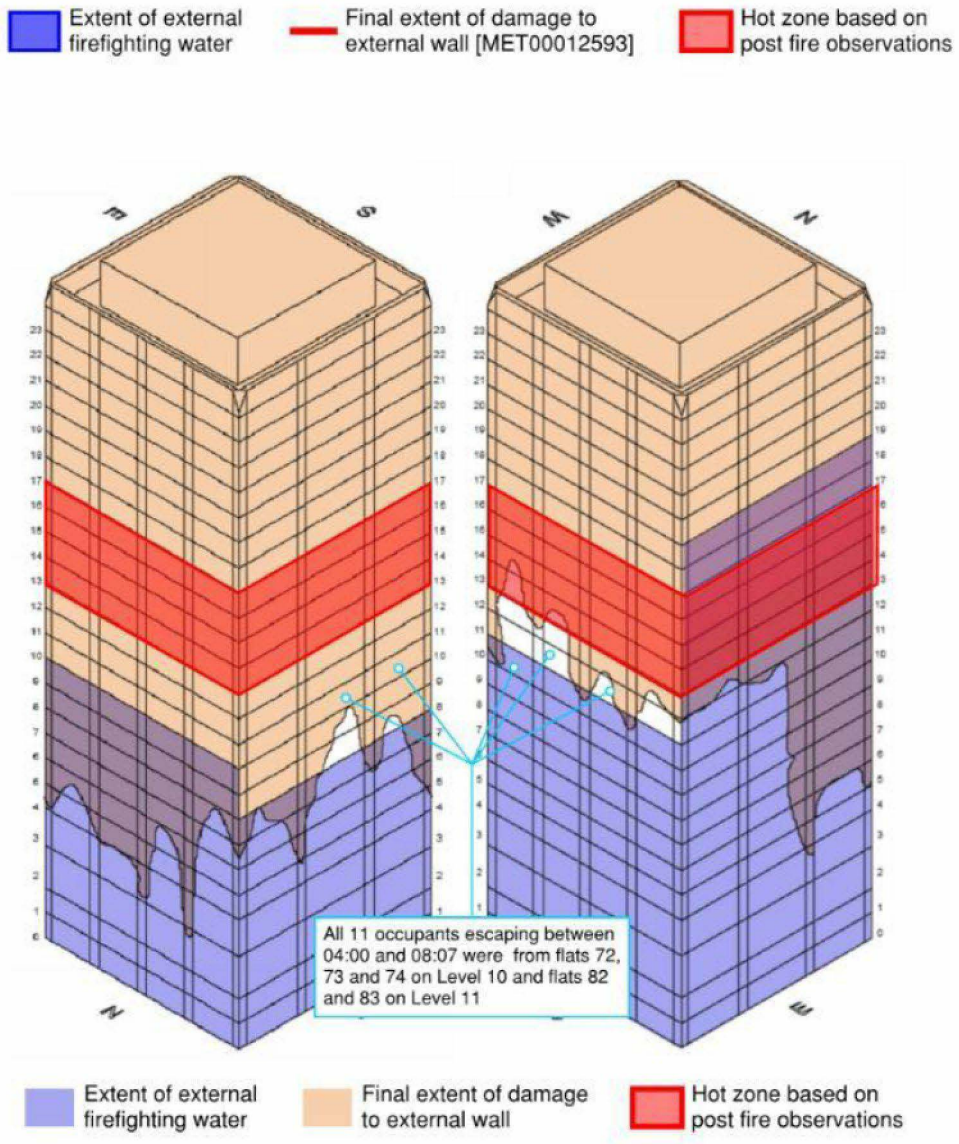


Figure 14.32: Estimated extent of external firefighting water coverage prior to 04:40am (Section 17), extent of external fire spread (Section 5, 12) and the hot zone within the protected stair as described in this Section 14 from post fire inspections.

14.4.157 Evidence of times of resident movement

14.4.158 Table 14.7 presents an analysis of the evacuation times of residents, based on the MPS record of exit times taken from CCTV footage of Grenfell Tower (MET000016072).

14.4.159 Table 14.7 shows evacuation during 7 different times in the fire. The first 3 times correspond to evacuations in the first hour, broken into 3 equal periods of 20 minutes. The next 3 entries are periods of approximately 1 hour each, while the final entry is the remainder of the time after 04:47 until the final resident escapes at 08:07. Against each of these times is noted the number of people escaping and which floors they escaped from.

14.4.160 Evidence from the LFB thermal imaging cameras identifies that the initial firefighting teams approached the flat entrance door to Flat 16 at 01:07. By 01:14 the teams were approaching the kitchen where the fire was located and by 01:21 the team were moving around the kitchen having apparently extinguished the fire there (please refer to Section 13 for further information on key timings).

14.4.161 Table 14.7 identifies that 34 residents left the building before 01:18. As noted in Section 13, by this time the fire had spread to approximately 32m above the ground on the outside of Grenfell Tower.

14.4.162 110 residents evacuated in the next 20-minute period until approximately 01:38. It is at this time that my review of witness statements, presented above, has identified the presence of a significant amount of smoke in the evacuation and firefighting stair. At 01:40 there were still 150 residents inside the building.

14.4.163 In the time period of 01:39 to 01:58 the evacuation rate slows significantly from 5.5 people/minute to 1 person/minute. This is a reduction of a factor of 5.5. Between 01:59 and 02:58 the evacuation rate reduces further to 0.4 people/minute.

14.4.164 In this time period, 01:39 to 01:58, some LFB crews accessing the Grenfell Tower were still advising residents to stay in their flats or in another flat on that floor, consistent with the stay-put policy (for example Foster MET00010084 and Murphy MET00010820 on Level 14).

Table 14.7: Evidence of evacuation from the upper floors at the start and the end of the evacuation phase

Time period	Residents evacuated in time period	Levels from which residents escaped in time period (no. of occupants from each level in brackets)
00:58 – 01:18	34	3(2), 4(13), 5(2), 6(1), 8(4), 12(1), 13(10) and Unknown (1)
01:19 – 01:38	110	1(6), 2(3), 3(2), 5(10), 6(2), 7(11), 8(8), 9(13), 10(3), 11(8), 12(2), 13(7), 14(3), 15(7), 16(6), 17(9), 18(2), 19(3), 20(2), 21(1) and Unknown (2)
01:39 – 01:58	20	1(2), 4(3), 6(6), 7(3), 10(1), 11(2), 20(2) and Unknown (1)
01:59 – 02:58	24	3(5), 5(2), 9(2), 12(4), 14(4), 15(1), 19(3), 20(1) and 23(2)
02:59 – 03:55	24	12(5), 15(1), 16(2), 18(8), 21(6) and 22(2)
03:56 – 04:47	9	10(6) and 11(3)
04:48 – 08:07	2	10(1) and 11(1)

14.4.165 Figure 14.33 and Figure 14.34 shows the fire observed in the cladding at approximately 01:20 and 01:40, to coincide with the end of the first and second 20 minute periods respectively.

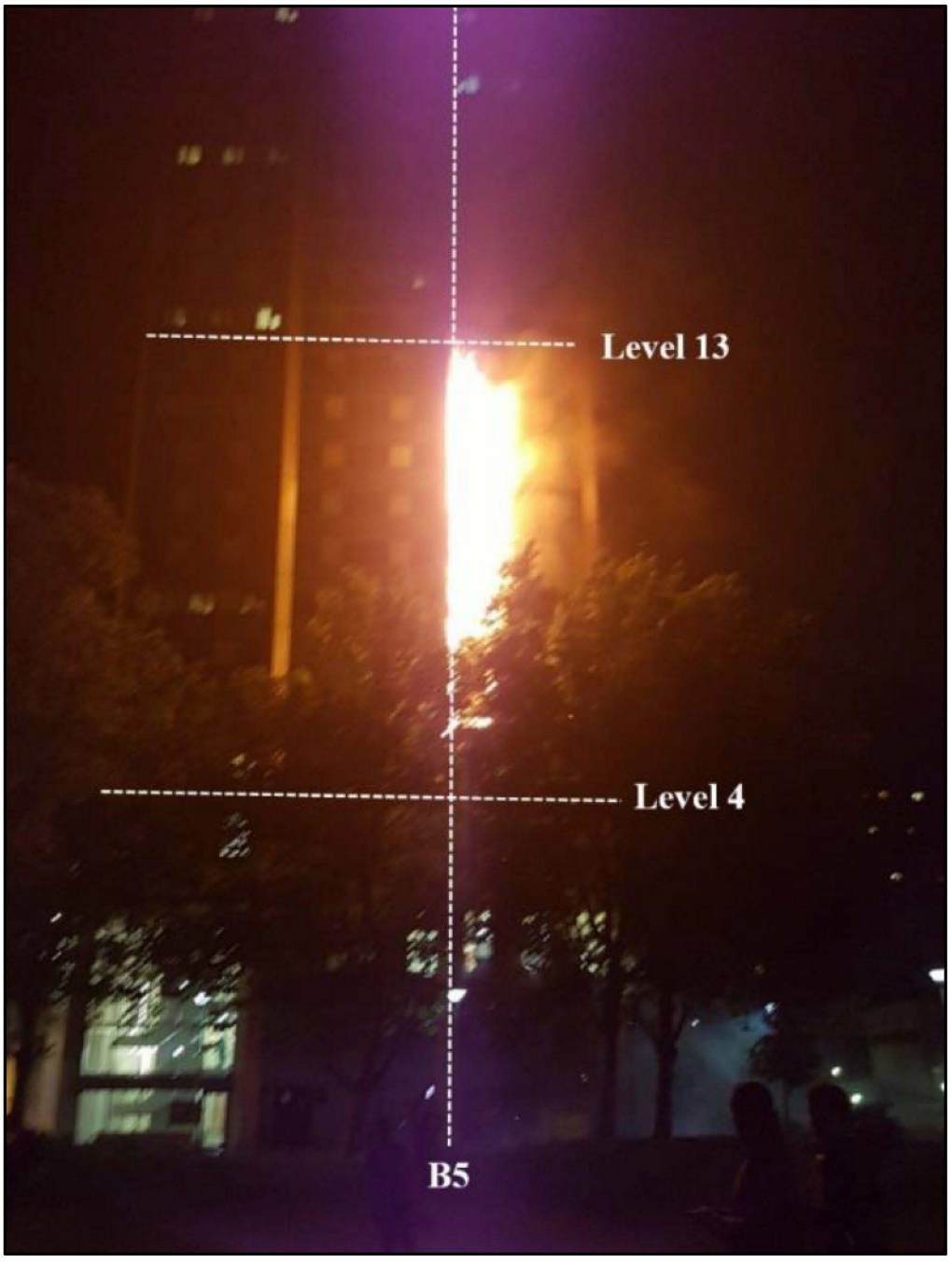


Figure 14.33: Fire on East elevation of the building envelope at 01:22 on 14th June 2017 (MET00012593)

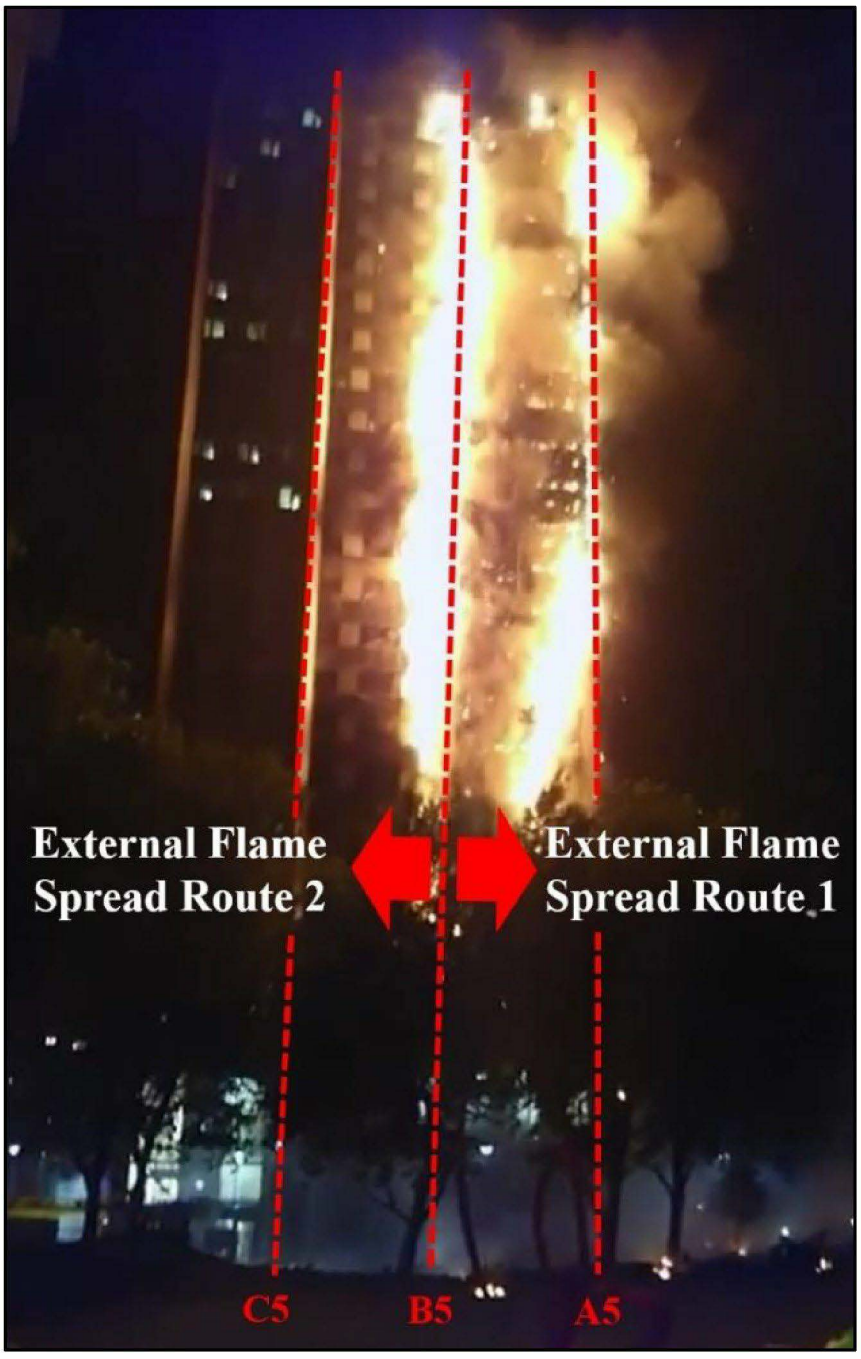


Figure 14.34: Fire on East elevation of the building envelope on 14th June 2017, estimated time 01:36

14.4.166 I have drawn the following conclusions from my analysis of this data:

a) Before 01:18, occupants were escaping from all floors up to Level 13 only.

b) Between 01:19 and 01:41, the largest number of evacuations occurred (114). Residents of every floor escaped during this time, except Levels 4, 22 and 23. Out of the 114 residents that escaped in this time period, 31 of them were from Flat "6", above Flat 16 on Level 4. Residents reported

smoke in the stair as early as 01:20 and poor visibility in the stair by 01:40.

c) Between 01:20 and 01:49, several residents moved from lower levels of the building to higher levels. Refer to Section 14.6 and Section 20 of my report.

d) Between 01:42 and 02:24, 24 people escaped. All residents that escaped in this time period were from Level 11 or below, which is below the hot zone. There were between 8 and 28 firefighters in the building in that time frame, on several different floors (Table 14.4Figure 14.35). A total of 46 firefighters were committed beyond the bridgehead during this time period.

e) As described in 14.4.87, at approximately 02:10, a door was held open for several minutes while FF Desforges (MET00008013) searched a lobby between Level 10 to Level 14, which was severely affected by heat and smoke. Based on witness statements from firefighters and residents, the stair was affected by smoke and heat at this time.

f) It now seems likely that residents above Level 11 could not escape at this time due to the resulting conditions in the stair. Conditions on the stair appear to have been such that the stair lights on Level 13 -16 were melting at that time. Temperatures of 150°C would have caused immediate pain to exposed skin. Therefore, it would likely have caused a physical and psychological barrier to escape.

g) 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 CROs), the existing evidence indicates that at 02:35 Jo Smith instructed the control room officers to change advice to FSG callers from stay put to leave (Transcript of 11th/12th July 2018). I have calculated that before the stay put guidance began to change at 02:35, 177 occupants evacuated independently, some with fire brigade assistance. At that time, there were 117 occupants remaining in the building, and ultimately only 46 of these occupants were able to evacuate.

h) Between 02:59 and 03:55, 5 people escaped from below the hot zone and 19 people escaped from above. This indicates that conditions on the stair could not have been such that the stair lights on Level 13 -16 were melting at that time.

i) I consider this supporting evidence that the hot zone may have been a temporary condition around 02:00 – 02:30.

j) Regarding those 20 people:

    i. The 8 people escaping from Level 18 were from 3 flats (152, 153 and 155) and all exited between 03:12 and 03:18 (6 minutes), this was a group of neighbours moving together, rescued by multiple firefighters.

ii. The 2 people from Level 22 were from the same flat (195) and both exited at 03:31.

iii. The 6 people on Level 21 were from 3 flats and all exited between 03:37 and 03:51 (14 minutes).

iv. The 2 people escaping from Level 16 were both from Flat 133 and exited 03:47.

k) After 03:56, all 11 evacuations were from below Level 13. Based on the MET record of CCTV footage (MET00016072), 9 out of these 11 residents were escorted or carried through the main entrance foyer by firefighters.

l) Between 03:56 and 04:47 6 residents escaped from Level 10 in 2 distinct groups, the first (Flat 74) leaving at 04:12 and the second (Flat 73) leaving around 04:20. Three people from Level 11 also evacuated, and these were a single family group all leaving at 04:47.

m) At approximately 04:15, Gallagher (transcript 10th September 2018, p31) reported that firefighters were not able to pass Level 12.

n) After 04:47 there are 2 individuals that escaped independently, from Level 10 at 06:05 and Level 11 at 08:07, both below the hot zone.

14.4.167 I have not yet been able to conclusively determine the time the hot zone occurred in the stair between Level 13 and Level 16. Currently the strongest evidence of the cause of the plastic light damage is smoke and heat entering the stair from open doors to the lobby during the fire event. It is most likely the cause of heat damage in the stair to the plastic lights was a temporary condition. The best current evidence is that this occurred around 02:00 – 02:30.

14.4.168 The conditions and events which may have led to the stair doors being kept ajar during the fire therefore require further investigation.

14.4.169 Based on the evidence contained in the CCTV review document (MET00016072) I understand the following:

a) 9 residents used the lift to evacuate the building.

b) 187 residents self-evacuated, down the stairs

c) 25 residents are recorded as being escorted by firefighters as they escape

d) 28 residents are recorded as being assisted or carried out of the building by firefighters (note that this includes the 7 residents that were pronounced deceased outside the tower).

14.4.170 "Escorted", "assisted" and "carried" are terms used in CCTV review document (MET00016072). I have assumed that they mean the following:

a) Escorted – a firefighter was near the resident, however the resident was moving unassisted

b) Assisted – a firefighter was supporting the resident in some way

c) Carried – the resident was physically carried by the firefighter

14.4.171 It is important that this evidence is corroborated in the next phase of the Inquiry.

14.4.172 **Fire Survival Guidance Calls**

14.4.173 A fire survival guidance call is defined in Appendix 3 of LFB Policy 539 (LFB00000737) as

"The London Fire Brigade define a Fire Survival Guidance call as being a call to Brigade Control where the caller believes that they are unable to leave their premises due to the effects of fire, and where the Control Room Officer remains on the line providing appropriate advice until either the caller is able to leave by their own means, is rescued by the Fire brigade or the line is cleared."

14.4.174 I have analysed a spreadsheet log of 999 calls (MET00014452) to determine at what point FSG calls were being made, and when they stopped, in specific areas of the building. I have done this to provide information on when conditions within those specific areas of the building became untenable. This is relevant to my analysis of the conditions in the stairs and lobbies

14.4.175 Column B of the spreadsheet log (MET00014452) provides a list of 999 call reference numbers. Each reference number identifies if the call was an FSG call or "other". Amongst other information in the log, each call is provided with a start time, duration and end time. In my analysis I have assumed that only the calls tagged as "FSG" were in fact FSG calls and therefore made by residents within the building who could not escape on their own. I have not undertaken any further analysis of the calls to determine the accuracy of the FSG tag.

14.4.176 Calls tagged as "other" in the spreadsheet may have been made by callers outside the building. Therefore, while they may have been made on behalf of residents still within the building, they are not FSG calls and do not provide direct evidence of the conditions faced by the residents trapped in the building.

14.4.177 On this basis, I have analysed the number of FSG calls made during 15 minute periods from flats above and below level 13 from 0115 to 0444. I have overlaid the graph of the number of firefighters working beyond the bridgehead in Grenfell Tower at a given time that I presented in Section 13, based on BA telemetry (LFB00023326).

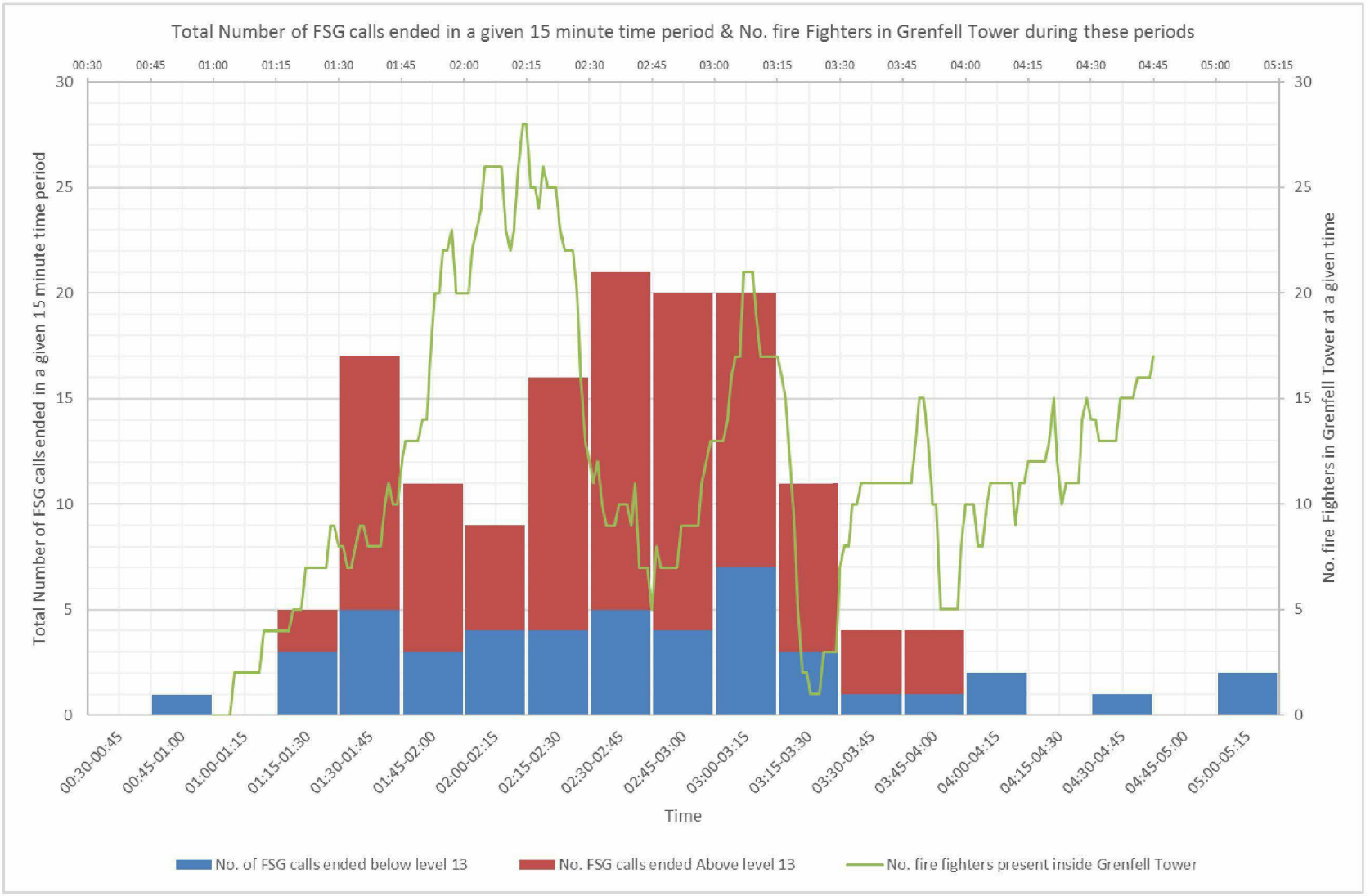


Figure 14.35 Frequency of FSG calls vs time & No. Firefighters in Grenfell Tower at start of time interval

14.4.178 It can be seen in Figure 14.35 that there was an initial surge of FSG calls between 0130 and 0145 (23 calls in total).

14.4.179 The number of firefighters beyond the bridgehead in Grenfell Tower increased from 5 at 0115 to 28 at 0215.

14.4.180 Between 02:15 and 02:45 the number of firefighters beyond the bridgehead in Grenfell Tower reduced from 28 to 5. During this period the number of FSG calls recorded as finishing increased from 12 between 02:15 and 02:30, to 23 between 02:45 and 03:00. Note that my Figure 14.35 does not record the duration of calls, but only indicates the number of calls that completed within each time period.

14.4.181 The number of firefighters increased again from 5 at 02:45 to 21 at 03:09.

14.4.182 From 03:09 to 03:24 the number of firefighters reduced from 21 to 1. During this period the number of FSG calls reduced from 23 to 10. The number of FSG calls then further reduced to 0 calls between 04:00 and 04:30.

14.4.183 At 03:50 the number of firefighters increased again to 15 before reducing to 3 at 04:04. After 04:04 the number of firefighters trended upwards.

14.4.184 Section 20 of my report identifies the location of deceased residents. I have cross referenced these flat numbers against the time the last FSG calls ended. This is also shown in table below.

Table 14.8 Last recorded call from flats where more than three deceased residents was found

Level	Flat	End of last recorded FSG call from inside flat [LFB00004695]	Transcript relativity reference	Number of fatalities recovered from flat [MET00012529]
14	113	03:19	LFB00000418	3
17	142	03:20	LFB00000419	4
21	182	02:58	LFB00000390	5
22	193	03:38	LFB00000422	11
23	201	02:24	LFB00000486	7
23	202	*No calls attributed to Flat 202 in MET00014452. Two calls from Level 23 not assigned to a flat – to be further investigated		4
23	203	02:44	LFB00000375	6
23	205	02:30	LFB00000670	4

14.4.185 Summary of findings

14.4.186 In this section I have presented observations from my post-fire inspection, and from witness statements of firefighters and residents, regarding the condition of the stairs in Grenfell Tower on 14th June 2017. I have also presented an analysis of movements of escaping residents and arriving firefighters at specific times.

14.4.187 Table 14.9 presents a summary of some key statistics over the course of the fire.

Table 14.9: Key statistics at specific times

Time	Incident Commander	Bridgehead Commander	FSG calls received	Max firefighters beyond bridgehead	Highest floor FF reached	Residents evacuated
00:58-01:50	WM Michael Dowden	O'Keefe	33	14	20	164
01:50-02:15	SM Andrew Walton	O'Keefe	16	28	20	5
02:15-02:44	DAC Andrew O'Loughlin	Welch	33	25	22	14
02:44-04:15	AC Andrew Roe	Welch/ Goulbourne	60	19	19	31
04:15-07:30	AC Andrew Roe	Welch/ Goulbourne	1	26	12	8

14.4.188 Below is a summary of the key points presented so far:

a) The fire in the building impacted the stairs on all levels between 4 to the top level 23.

b) In general, from 0:55 to 01:20 the stairs appear to have been free of smoke and therefore tenable for escape.

c) Between 01:20 and 01:35 smoke started to penetrate into the stairs, but not in sufficient volume to significantly affect visibility in the stair on Level 4 – 15.

d) Firefighters reported that conditions within the stair began to deteriorate rapidly in this time period. Residents reported poor visibility in the stair by 01:40.

e) At approximately 01:40 the rate of residents leaving the building slowed as shown in Figure 14.21.

f) Between 01:20 and 01:49, several residents moved from lower levels of the building to higher levels; refer to Section 14.5 and Section 20 of my report.

g) Firefighters reported heat in the stair by approximately 01:57.

h) The earliest resident witness statement I have reviewed that reports heat in the stair is from a resident that escaped by 02:32.

i) The stairs between Levels 13 and 16 show evidence of high temperatures (above approximately 150°C as evidenced by the melted lights) which correlates to witness statements regarding conditions on those levels. I call this a hot zone.

j) The hot zone in the stair may have prevented its use by residents temporarily some time around 02:00 – 02:30.

k) Current evidence indicates the hot zone in the stair between Level 13 and 16 may have been caused by smoke and heat entering the stair from open doors to the lobby during the fire event. A door between Level 10 to Level 14 lobby was blocked open around 02:10 while firefighters completed specific firefighting rescue activities in the lobby.

l) Between 01:40 and 02:47 only an additional 43 residents were able to escape. Between 02:35 and 02:47 the evacuation guidance to residents was changed by LFB staff from Stay Put.

m) At 02:35 there were still 117 people within the building. Ultimately however only 46 of these people were able to evacuate.

n) Between 02:59 and 03:55, 4 people escaped from below the hot zone (Level 13-16) and 20 people escaped from above. This supports the evidence that the hot zone in the stair was a temporary condition.

o) After approximately 04:00, no residents escaped from above Level 11 and no firefighter was able to travel above Level 12. The conditions in the lobbies were at their worst by this time.

p) Additionally, based on my analysis in Section 12, internal fires progressed around the building as the external flame front progressed. By 02:47, 56 flats had now been impacted by the external flame front, and that has risen to 92 flats by 04:00. Please refer to Section 12 of my Phase 1 report.

q) Between 03:08 and approximately 09:00 the Bridgehead was located at ground level indicating that the whole height of the stair was considered by the LFB as not safe to enter without Breathing Apparatus during this period. Despite these conditions, 35 residents were able to escape from floors as high as Level 22.

r) I am aware residents on the higher floors did not feel they were able to escape downwards as the conditions local to them were too severe. There have been reports of people moving upward within the building to a place of perceived safety. Please refer to Section 14.5 and Section 20 of my report where this issue is analysed further.

s) My analysis in Sections 14.5 and in Section 20, identifies that the remains of 35 people, 50% of the fatalities recovered at Grenfell Tower, were found on Levels 22 and 23 (11 persons on Level 22 and 24 people on

Level 23). I believe thirteen of these people were not originally located on Levels 22 and 23 at the time the fire started.

14.4.189 The impact of fire but particularly smoke and other products of combustion on the welfare of adults and children who did manage to enter the stair, require substantial analysis to provide further information regarding the toxicity of conditions in the stair.

14.4.190 The conditions of the lobbies are also very relevant here, and these are described in Section 14.6.

14.5 Evidence of people moving up the building

14.5.1 From the MPS record of the locations of deceased persons recovered in Grenfell Tower (MET00012529), it appears that a number of people had left their floor of origin and moved up the building instead of escaping downwards.

14.5.2 I have extracted information from this document (MET00012529) to analyse how people moved in the building and presented this in Tables 1 and 2.

Table 14.10: Movement of fatalities listed by floor of origin

Floor of origin	Number of fatalities originating on the floor	Movement from floor of origin		
		Number of fatalities who stayed on the same floor	Number of fatalities who moved to a higher floor	Number of fatalities who moved to a lower floor or outside
11	2	1		1
12				
13				
14	4	3		1
15	1	1		
16	2	2		
17	7	6		1
18	6		5	1
19	8		7	1
20	9	2	1	6
21	6	6		
22	14	11	2	1
23	11	9		2

Table 14.11: Movement of fatalities listed by final floor

Final floor	Number of fatalities discovered on the floor	Number of fatalities who stayed on the same floor	Floor of origin of fatalities who moved to this floor (number of fatalities from floor of origin)
Outside	7		11(1), 14(1), 17 (1), 19(1), 20 (1), 23(2)
9	1		20(1)
11	1	1	
13	2		18(1) 20(1)
14	3	3	
15	1	1	
16	2	2	
17	6	6	
18	1		22(1)
19	3		20(3)
20	2	2	
21	6	6	
22	11	11	
23	24	9	18(5), 19(7), 20(1), 22(2)

14.5.3 The data provided in MET00012529 shows the following movements:

a) 41 fatalities were recovered on their floor of origin, with 29 recovered from within their flat of origin.

b) 7 fatalities were recovered on a lower floor than their floor of origin or outside the building.

c) 15 fatalities were recovered on a higher floor than their floor of origin.

d) 7 fatalities were recovered outside of Grenfell Tower.

e) A further two fatalities occurred in hospital at a later date.

14.5.4 The highest number of fatalities (24) on a single floor were recovered from the 23rd floor. This included 5 residents from floor 18 and nine residents from floor 19, 1 resident from Level 20 and 2 residents from Level 22. Only 9 of the fatalities recovered from floor 23 had originated from that floor.

14.5.5 The 6 fatalities recovered on floors 18 and 8 fatalities on floor 19 had moved away from their floor of origin.

14.5.6 All fatalities originating from floors 15, 16 and 21 had remained on those floors, with all but one from floor 17 remaining on that floor.

14.5.7 None of the fatalities discovered below their floor of origin were located within a flat. These fatalities were all located within a lobby, the stair, or outside the building.

14.5.8 Residents on each floor appear to have made different decisions as to whether to stay in their flats, to move to higher floors or to attempt to escape from the building. I analyse their movements in detail in Section 20 of my report.

14.5.9 In this section, I present evidence from resident witness statements of people moving up the building. Based on the evidence presented below, residents moved up the building between 01:20 and 01:49.

14.5.10 Naomi Li lived in Flat 195 on Level 22. In her witness statement, Naomi Li (IWS00000515) explained that she entered the stair between 01:21 and 01:30 and saw people walking up the stair. She didn't speak to anyone but decided not to leave the building at this time:

> 45 We immediately went to the staircase and opened the emergency door At that point we intended to walk down the stairs and leave the building
>
> 46 We saw a lot of people walking up the stairs I can't remember how many people were walking up It was a lot, enough to mean we could not go downstairs It was people constantly walking up There was hazy smoke in the staircase at that point They looked normal walking upstairs, not screaming, running or anything unusual We didn't talk to anyone I was a bit stunned at that point, people walking upstairs wasn't something I expected to see
>
> 47 I can't even remember details of the people walking up I didn't see anyone I knew or recognised, but I didn't know that many people in the Tower.
>
> 48. I closed the emergency door quickly, turned around to say to Lydia 'I think the door is locked upstairs, we can't go upstairs' I assumed they were trying to get onto the roof and meant that the door to the roof was locked

14.5.11 Several resident witness statements indicate that they were told to move up the building by other either firefighters or other residents.

14.5.12 Fadumo Ahmed lived in Flat 164 on Level 19. According to her witness statement (IWS00000729), she left her flat soon after 01:20 and was told by her neighbour, Debbie Lamprell (Flat 161) that people were going upstairs:

eyes and I just wanted to cover my eyes because of the pain on my eyes. I could see my neighbour, Debbie Lamprell, standing opposite the two lifts near the cupboard doors. There is a cupboard opposite the two lifts and she was next to this. She lived on the same floor as me and had the corner flat, number 161. She looked frightened and said to me that people were going upstairs. I thought that she had instructions to go upstairs. She was not panicking but it was as though she had been given an instruction. It was also clear that fire was lower down the Tower and walking down towards the fire made less sense. I had known Debbie since I moved in and so I thought I should do what she said.

~~14.5.13~~ Meron Mekonnen lived in Flat 163 on Level 19. In her witness statement (IWS00000912) and her evidence (Transcript 9th October, p29), Meron Mekonnen explained that she attempted to leave the building with her children. When they reached roughly Level 16, she heard a person shouting, *"Go back, go back"*. She and her daughters moved up the stair, along with several other people. However, when she reached the Level 19 stair landing with her daughters, she decided to leave the building despite the advice from the person shouting in the stair. Meron Mekonnen and her children exited from the building at 01:32 according to the MET record of CCTV footage (MET00016072).

14.5.14 According to the witness statement of Ahmed Elgwahry (IWS00000988), Mariem Elgwahry and Eslah Elgwahry tried to escape before 01:49 but were told by others to go back up the stairs and instead went to Flat 205 on Level 23.

"Mariem called again at 1:49 AM and this was for a minute. I think this is when she told me that she had tried to go down the stairs but couldn't as there were others going back upstairs and were telling her to go back up. I don't know how far down the stairs she went. She said that the neighbor in Flat 205 had let her and my mum in."

14.5.15 Flora Neda lived in Flat 205 on Level 23. In her witness statement (IWS00000887) she explained that several people moved up the building to Level 23 and four people entered her flat. Based on the witness statement of Ahmed Elgwahry (IWS00000988), the activity explained below appears to have happened before 01:49.

"As I left the flat again and went on to the landing with Saber and Farhad, I saw approximately 30 to 40 people coming on to our landing from up the stairs. I asked them what was going on. They were knocking on our other neighbours' doors telling them that there was a fire downstairs and that they needed to come out. They told us that they had been told to come upstairs as a rescue helicopter was coming for us.

...

Sakina told me that there was a fire and that she had been told to go upstairs by the Fire Brigade as a helicopter was coming to rescue us. They came into our flat and she kept walking around asking Saber and me, "When is the helicopter coming?" I told them that there was no access to the roof and that the door was locked. They again repeated, "They told us we have to go up." Four people came into our flat to get away from the fire.

…

It was Sakina and Fatima who told me that they had been told to go up the stairwell. When I asked Mariem why she had come up she had told me, "There is a fire on our [their] side of the Tower and it had spread very quickly and was coming up the Tower. The stairwell is packed with people and there is no way out."

14.5.16 Farhad (Shekeb) Neda also lived in Flat 205 on Level 23. He also describes being told to move to the top floor (IWS00000886). Farhad (Shekeb) Neda reported that there was not much smoke on Level 23, but other residents said there was no way out through the stairs:

"We (me, my mum and my dad) got dressed again and we left the flat, locked our front door and we even went into the staircase. At that point we saw people from downstairs coming up towards us. These people were our neighbours from lower floors. They were coming up and telling us that there was a fire in the Tower and that they had been told to come up to the top floor. They told us that there was no way out through the stairs. At this point there was not much smoke on our floor and I could still see clearly.

…

When I had met the people coming up the stairs and on to our landing they had said there was a fire downstairs and they had been told to go up to the top as they would be rescued by the Fire Brigade. A lot of people had come up to our floor, I cannot be sure of the number but there were a lot. Four people had come into our flat making us 7 in total."

14.5.17 Based on these witness statements, there were several potential reasons people moved up the building, including:

a) LFB and/or other residents told them to move up the building; or

b) They saw other residents moving up the building; or

c) The stair was full of people and they did not perceive it to be a safe escape route.

d) Several witness statements mentioned their belief that a helicopter was going to rescue residents from the roof, however none of the other evidence I have reviewed has indicated that the LFB told residents to go to the roof for a helicopter rescue.

14.6 The protected lobbies

14.6.1 Evidence from the post fire damage site inspection

14.6.2 My team and I inspected the lobbies and fire doors between 7th November 2017 and 9th November 2017. Each lobby was visually inspected. I did not move or remove for inspection any items during this inspection. Photographs were taken of areas of note only. Please refer to Section 14.4.1 and Appendix C for details of the post fire building inspection referred to in this section.

14.6.3 To describe the damage observed, I have categorised the damage I observed within the lobbies using the same criteria of soot depositions and heat damage to plastic light fittings I applied to the stairs.

14.6.4 I have also considered damage to surface linings and partitions, which are more numerous within the lobby.

14.6.5 Table 14.12 describes the damage category, its definition and the criteria applied to the collected evidence for each category.

Table 14.12: Lobby damage assessment categories & associated assessment criteria

Damage Category	Category Definition	Assessment Criteria [1, 2]
No Damage	No relevant damage observed	None
Light Damage	There may be smoke deposition on internal linings, but there is no physical damage to the fabric of the building, fixtures, or fittings.	Soot deposition
Medium Damage	There may be physical damage to the fixtures or fittings, but damage to the fabric of the building is limited to bubbled paint on the walls and ceilings.	Softening or melting of light(s)
		Charring or deformation of plastic smoke extract switch
		Paint bubbled on walls &/or ceiling
		Intact flat entrance doors (Table 14.2)
		Charring or deformation of Northwest & Southwest riser coverings [3]
Heavy Damage	There may be damage to the fabric of the building.	Damage to floor surface cover (revealing brick floor) [4]
		Damaged or missing flat entrance doors (Table 14.2)
		Damaged or missing stairway door
		Damaged or missing doors and partitions to centre riser [5]
		Damaged or missing refuse chute access door
		Damage to plasterboard ceiling – caused by heat [6]
		Evidence of spalling of concrete on any surface

[1] The *Medium Damage* category may include any of the assessment criterion listed under the *Light Damage* category. The *Heavy Damage* category may include any of the assessment criterion listed under the *Medium Damage* category.

[2] If any one of the criteria listed is met, the area is categorized per the higher damage level.

[3] The Northwest and Southwest risers adjacent to the lifts appear to be covered by a chipboard material.

[4] Floor damage appears to be limited to the floor surface lining; no damage to the brick beneath is observed. Where floor damage is present, is it in irregular patterns. NFPA 921 section 6.2.7.8.2 notes *"Irregular patterns are common in situations of post-flashover conditions, long extinguishing times, or building collapse. These patterns may result from the effects of hot gases, flaming and smouldering debris, melted plastics, or ignitable liquids."*

[5] The riser on the east of the lobby (referred to herein as "centre riser") appears to be enclosed by partition walls constructed of plasterboard and separated from the lobby by a fire door (as indicated with signage on the door).

[6] A plasterboard ceiling is installed near the flat entrance doors on the north and south of each lobby. It was observed that the plasterboard ceiling has been removed by others in several locations post-fire. "Damage to plasterboard ceiling – caused by heat" refers to damage that appears to have been caused by heat, as indicated by the damage of the associated metal framing and/or soot deposition on the slab above.

14.6.6 I have categorised the damage to stairway doors, flat entrance doors, and refuse chute doors using the damage definitions in Table 14.2. The damage of these doors serves as criteria in the lobby damage assessment. Samples of doors for each classification are provided in Figure 14.7.

14.6.7 I have provided examples in Figure 14.8. Figure 14.9 and Figure 14.10 to illustrate the lobby damage records from my site inspection for Levels 4, 13 and 23. I have assessed Levels 03 – 23 of Grenfell Tower; full details are provided in Appendix C.

14.6.8 **Observed damage to the lobbies**

14.6.9 Figure 14.36 summarises the observations made in the north and south side of each lobby. The colour indicates the damage categorization per the definitions described in Table 14.12.

14.6.10 As well as comparing the relative damage between lobbies on different levels, I have compared the damage between the north side and south side of each lobby. This has been done to identify if significantly different conditions are likely to have been experienced by escaping occupants and firefighters on different sides of the building. This is relevant because it may indicate different severities of compartment fires in the flats on one side of the building compared to the other.

14.6.11 Table 14.13 describes the types of damage observed on each level.

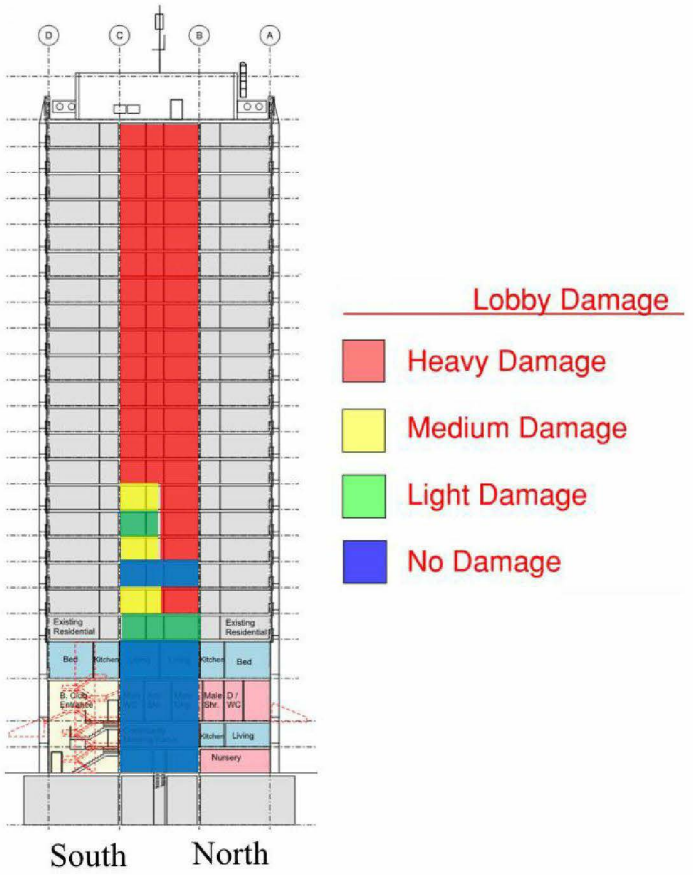
14.6.12 It is evident that significant damage is present across the whole lobby from Level 10 to the top of the building. Between Level 5 and Level 9 the damage in the lobbies is less on the south side, compared to the north side.

14.6.13 This indicates that the conditions on the south side of the building during the fire may have been less severe.

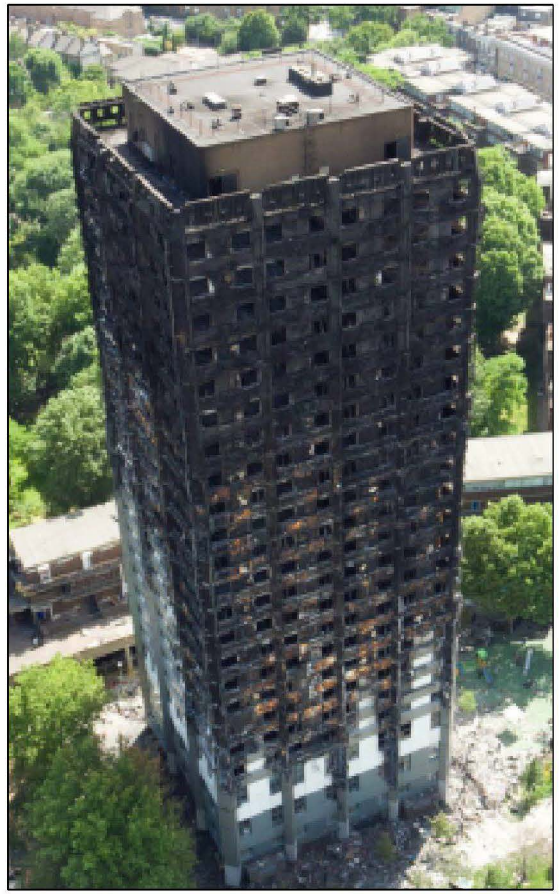
14.6.14 This observation agrees with the observations of damage to the building envelope (MET00012593), where the North elevation of the building envelope shown significant damage down to Level 3, while damage on the South elevation of the building envelope is only significant from Level 10 upward. (See Section 4 and Figure 14.36)

14.6.15 The plasterboard ceilings installed in the areas around the flat doors on the north and south ends of the lobbies are partially or completely collapsed on all floors from 10 to 23, except in Level 15 where the ceilings are damaged to a lesser extent than on the adjacent floors.

(a) South building envelope of Grenfell Tower, UAV image taken on 10/06/2017 (MET00012593)



(b) North – South Lobby damage observations (SEA00009461)



(c)North building envelope of Grenfell Tower, UAV image taken on 10/06/2017 (MET00012593)

Figure 14.36: Comparison of externally observed damage to (a) North and (c) South elevations with damage recorded to internal lobbies

Table 14.13: Summary of damage observed on each level

Level	Area	Evidence Observed
Ground	North	None
	South	None
1	North	None
	South	None
2	North	None
	South	None
3	North	None
	South	None
4	North	Soot deposition
	South	Soot deposition
5	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling (L5-084), flat 26 entrance door is missing
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to smoke extract switch
6	North	None
	South	None
7	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, missing Northwest riser covering, missing flat 44 and 45 entrance doors, damaged refuse chute door, damage to plasterboard ceiling (L7-702)
	South	Soot deposition, paint bubbled on walls and ceiling, damage to smoke extract switch
8	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling (L8-719), missing flat 55 and 56 entrance doors
	South	Soot deposition
9	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, damage to Northwest riser covering, missing flat 65 and 66 entrance doors
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to smoke extract switch
10	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, missing Northwest riser covering, damaged centre riser door, missing flat 74, 75, and 76 entrance doors, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, missing Southwest riser covering, damage to central riser partition, damaged centre riser door, damage to smoke extract switch, damaged stair door

Level	Area	Evidence Observed
11	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, missing Northwest riser covering, damage to floor surface cover, missing flats 84 and 86 entrance doors, damage to centre riser door, damage to centre riser partition
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, damage to smoke extract switch, damaged stair door, flat 81 entrance door missing, damage to centre riser door
12	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, missing flats 94 and 96 entrance door, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, damage to smoke extract switch, damage to flat 93 entrance door, missing flats 91 and 92 entrance doors, damage to centre riser partition
13	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, damage to centre riser partition, damage to centre riser door, missing flat 104 and 105 entrance doors, missing centre riser door, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, damage to centre riser door, damage to centre riser partition, missing stair door, missing flat 101, 102, and 103 entrance doors
14	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, damage to centre riser partition, missing centre riser door, missing flats 114, 115, and 116 entrance doors, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, missing stair door, missing flat 111 and 112 entrance doors
15	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, missing flats 123, 124 and 125 entrance doors
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to smoke extract switch, missing flats 121 and 122, and 123 entrance doors, damaged Southwest riser cover

Level	Area	Evidence Observed
16	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing flat 134, 135, and 136 entrance doors, damaged Northwest riser cover, damaged centre riser partition, missing centre riser door, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing flat 131 and 132 entrance doors, missing stair door, damaged centre riser partition, missing centre riser door
17	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, damaged Northwest riser covering (with part of it missing), missing flat 144, 145, and 146 entrance doors
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to plasterboard ceiling, damage to Southwest riser covering, damage to smoke extract switch, missing flats 141, 142, and 143 entrance doors
18	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, damage to centre riser partition, missing centre riser door, missing flat 154, 155 and 156 entrance doors, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, missing stair door, missing flats 151, 152 and 153 entrance doors
19	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, damage to Northwest riser covering, damage to centre riser partition, missing centre riser door, flats 164, 165, and 166 entrance doors missing, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, damaged stair door, flat 161, 162, and 163 entrance doors missing
20	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, missing centre riser door, damage to centre riser partition, missing flats 174, 175 and 176 entrance doors, damaged refuse chute doors

Level	Area	Evidence Observed
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, damage to Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, missing stair door, missing flats 171, 172 and 173 entrance doors
21	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, damage to centre riser partition, missing centre riser door, missing flats 184, 185 and 186 entrance doors, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, missing stair door, missing flats 181, 182, and 183 entrance doors
22	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, damage to centre riser partition, missing centre riser door, missing flats 194, 195, and 196 entrance doors, damaged refuse chute door
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, missing stair door, missing flats 191, 192 and 193 entrance doors
23	North	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Northwest riser covering, damage to centre riser partition, missing centre riser door, missing flats 204, 205 and 206 entrance doors, damaged refuse chute doors
	South	Soot deposition, paint bubbled on walls and ceiling, lights damaged, damage to floor surface cover, damage to plasterboard ceiling, missing Southwest riser covering, damage to smoke extract switch, damage to centre riser partition, missing centre riser door, missing flats 201, 202, and 203 entrance doors, missing stair door

14.6.16 Evidence relating to lobby conditions from witness statements

14.6.17 I have reviewed the firefighter and resident witness statements and the transcripts of oral evidence of firefighters for evidence regarding the condition of the lobbies on the 14th June 2017.

14.6.18 I have found specific references to the conditions in lobbies which are collated in chronological order in Appendix N. These observations have been included in Figure 14.17 to Figure 14.30.

14.6.19 I have included evidence relating to the conditions in the Level 4 lobby in this Section 14 because this was the lobby adjoining to the flat where the fire originated, Flat 16. I have only included evidence until 01:20 because other lobbies were reportedly also affected by smoke by 01:20.

14.6.20 In summary, smoke is reported in lobbies at times that correlate closely with the times at which the fire in the external façade reaches those floors. For example, by approximately 01:23, smoke is first recorded in the lobby at Level 22. The cladding fire reached the top of the building at approximately 01:26.

14.6.21 Some flat entrance fire doors appear to have provided a complete barrier to the movement of smoke for only a few minutes. In his oral evidence, Stern (Transcript 19th July, p138) identified that smoke was passing through the door of Flat 26 on the 5th floor and into the Level 5 lobby by approximately 01:20. This is only 6 minutes after fire was observed to spread to Level 5 (please refer to my Section 5).

14.6.22 There is emerging evidence of smoke leaking out of the AOVs on both sides of the lobbies also, which requires investigation. In his oral evidence, Farhad Neda (Transcript 18th October, p41) identifies that smoke was spreading into the Level 23 lobby from the AOVs at both the North and South end of the Level 23 lobby.

14.6.23 Evidence relating to smoke spreading into flats from lobbies through closed flat front doors

14.6.24 There is specific resident witness evidence that smoke was able to leak into flats from smoke filled lobbies through the flat front door. A specific example from Gomes is presented in Figure 14.37, below.

> There was smoke coming in through the front door and I put wet towels at the bottom o the door and along the sides from top to bottom to cover the edges as the smoke wa coming in through all of the edges. I used the hooks on the door to hang the towels an sheets. It was not an air tight door and the smoke was seeping in. The smoke smelle toxic. Anytime I breathed it in, it made me gag.

Figure 14.37: Extract from witness statement of Gomes (IWS00000889)

14.6.25 Evidence relating to Level 4 lobby conditions before 01:20 from witness statements

14.6.26 Thirteen people escaped from flats on Level 4 before 01:20. I have reviewed the witness statements of these residents for evidence of the conditions within the lobby prior to 01:20.

14.6.27 I have specifically looked for evidence before and after 01:07 (Section 13) which is the time LFB entered Flat 16 and so the flat entrance door was held open by the firefighter hose.

14.6.28 Mahad Egal, was resident in Flat 15 and alerted their neighbour to the fire then escaped from the building with his family at 00:59 (MET00016072). He describes seeing "*dense, dark grey smoke cam whooshing past me into the flat behind me. I remember it blowing into my face*", as he escaped he observed the door to Flat 16 was open and smoke was "*billowing out into the corridor*" (IWS00001010).

14.6.29 Jamie Murray, resident in Flat 15 and alerted to the fire by Mahad Egal, escaped from the building with him at 00:59 (MET00016072). She describes light grey smoke billowing out from the Flat 16 door. She also recalls after entering the stairwell the smoke coming out behind them in draughts every time we opened a door (IWS00001008).

14.6.30 Therefore, prior to the LFB entering Flat 16 at 01:07 smoke was spreading into the Level 4 lobby through the door to Flat 16. The oral evidence from Batterbee (Transcript 28th June, p52) indicates that the door to Flat 16 had to be forced before firefighting could occur inside. Therefore, the door was closed at some point between the evacuation of the residents of Flat 16 and the arrival of the firefighters. The oral evidence of Badillo (Transcript 29th June, p81, excerpted below) also identifies that the front door to Flat 16 was closed when firefighters first arrived in the Level 4 lobby.

> So where was that wispy smoke that you could see?
>
> **A. I believe it was coming out of the door.**
>
> Q. Which door?
>
> **A. Sorry, the front door to flat 16.**
>
> Q. Was the door open or closed?
>
> **A. It was closed.**

14.6.31 An autodial system interfaced with the lobby smoke detection system was triggered at 00:55 (THL00000003). The specific location of the device that caused this activation is not specified in the evidence available to me at this time.

14.6.32 The resident evidence and CCTV footage from the lift confirms the presence of smoke within the Level 04 lobby shortly after Mr Kebede's 999 call at 00:54 (MET0004695). Therefore, in my opinion it is likely it was this smoke

witnessed in the Level 04 lobby which triggered a smoke detector and the autodial system.

14.6.33 Zoe Dainton, resident in Flat 12, was alerted to the fire by her neighbour, Mahad Egal from Flat 15. Mahad Egal had left the building by 00:59 and therefore she must have been alerted before this time. When she first looked into the lobby, after being alerted by her neighbour, she could not see or smell smoke (IWS00000806).

14.6.34 The second time she looked into the lobby she observed firefighters in the lobby and light thin smoke at the ceiling. By the time she did make her escape the lobby was full of thick black smoke which set off smoke detectors within her flat (IWS00000806).

14.6.35 Zoe Dainton escaped from the building at 01:13 (MET00016072). This is 18 minutes after the smoke panel informed Tunstall that it had been activated by a smoke detector.

14.6.36 Therefore, by 01:13 the lobby of Level 4 was filling with thick black smoke from Flat 16.

14.6.37 The lobby and stair smoke control system installed in Grenfell Tower was required to perform effectively during this period when the fire was still a single flat fire.

14.6.38 Mohammed Ahmed, a resident of Flat 102 on the 13th floor escaped from the building at 01:21(MET00016072); as he escaped past Level 4 he reports seeing three fire men at the stair door and thick black smoke coming from the hallway into the stairs.

14.6.39 Therefore, by 01:21 the thick black smoke seen in the lobby of Level 4 appears to have been spreading to the single stair of Grenfell Tower.

14.6.40 The observation of smoke flowing from the Level 4 lobby into the stair contributes to evidence of the installed smoke control system not performing effectively, during a single flat fire as is required.

14.6.41 Hoses were initially laid by Dorgu and Badillo within the Level 4 lobby, and therefore would not have blocked the stair door open. A hose is first laid through the door from the lobby at Level 3 into the lobby at Level 4 in order to permit firefighters Barton and O'Hanlon to act as a second crew in Flat 16.

14.6.42 Barton and O'Hanlon are recorded as leaving the bridgehead at Level 2 at approximately 01:12, and therefore, the Level 3 and Level 4 doors would have been blocked open by their hose at approximately this time.

14.6.43 As I explain in Appendix J, the smoke control system was designed to extract from the lobby to create a flow of air from the stair into the lobby. This system was designed for it to work with only one stair door open. As soon as doors from the lobby into any of the flats on Level 4 were opened, the performance of the smoke control system, in terms of pulling air from the stair, would have been significantly reduced.

14.6.44 Evidence of ineffective self-closing devices on flat front doors

14.6.45 I present in Appendix I a detailed assessment of the recorded certification and the expected performance of the flat front doors in Grenfell Tower. One of the key items I have identified with respect to the performance of the flat entrance doors is the issue of self-closing devices.

14.6.46 Concealed door closers were noted on all eight of the flat main doors surveyed by my site inspection team and me. These were all disconnected at the time of that survey therefore the action of the self-closers could not be verified.

14.6.47 Further to this, evidence taken from photographs disclosed by the MPS dated 17/06/2017 (three days after the fire) shows that door closers had been disconnected on ten flats. None of these flats were part of the eight that I surveyed.

14.6.48 One overhead door closer and one concealed door closer were observed in photographs disclosed by the MPS dated 17/06/2017 (three days after the fire) on flats 23 (MET00018892) and 34 (MET00018847) respectively. This is the only evidence I have to date that any door closers on levels 4-23 were connected on the night of the fire.

14.6.49 Based on witness statements I have identified an additional seven flats with ineffective self-closing devices on flat front doors.

14.6.50 A caretaker employed in Grenfell Tower has provided evidence (MET00019959) that they disconnected 10 door closers.

14.6.51 There is evidence of escaping residents and attending firefighters not deliberately closing flat entrance doors. As evidenced above, at least six of the self-closing devices on the flat entrance doors were not functioning on the night of the fire. If neither the residents, firefighters or self-closing devices effectively closed the doors to the flats, smoke and heat from the fire in the cladding, and the resulting fires within individual apartments, could flow rapidly into the associated protected lobbies on that floor.

14.6.52 Evidence from photographic evidence in the lobbies during the fire

14.6.53 Footage taken by residents indicates the conditions in the 5th floor lobby at 01:20, replicated in Figure 14.38. This example shows the loss of visibility of the escape route through the lobby, even though the lights were still operating. (MET00012593)

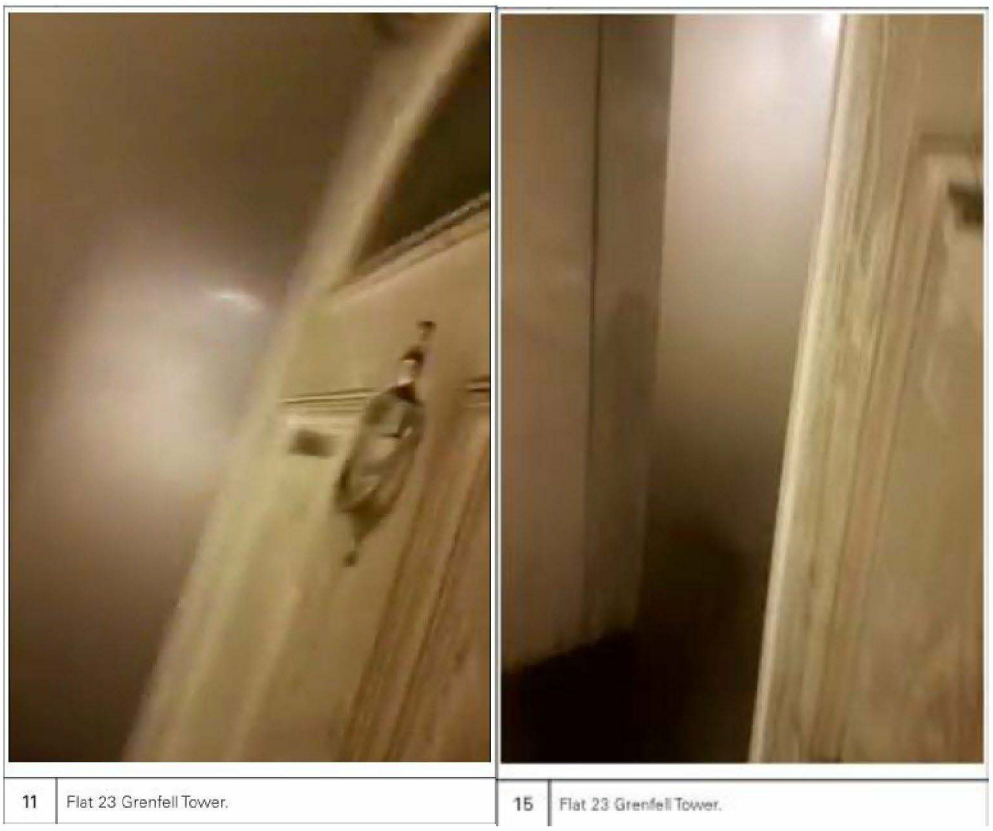


Figure 14.38: Smoke in Level 5 lobby at 01:20 (MET00012593)

14.6.54 Stills taken from CCTV footage (MET00012593), reproduced in Figure 14.39 to Figure 14.42, identify the changing conditions in the lobby of Level 7 at 01:40, 03:00 and 03:36. The conditions at 03:36 (Figure 14.42) indicate that the lighting has either failed, the CCTV camera has malfunctioned or complete obscuration of the light has occurred due to thick black smoke.

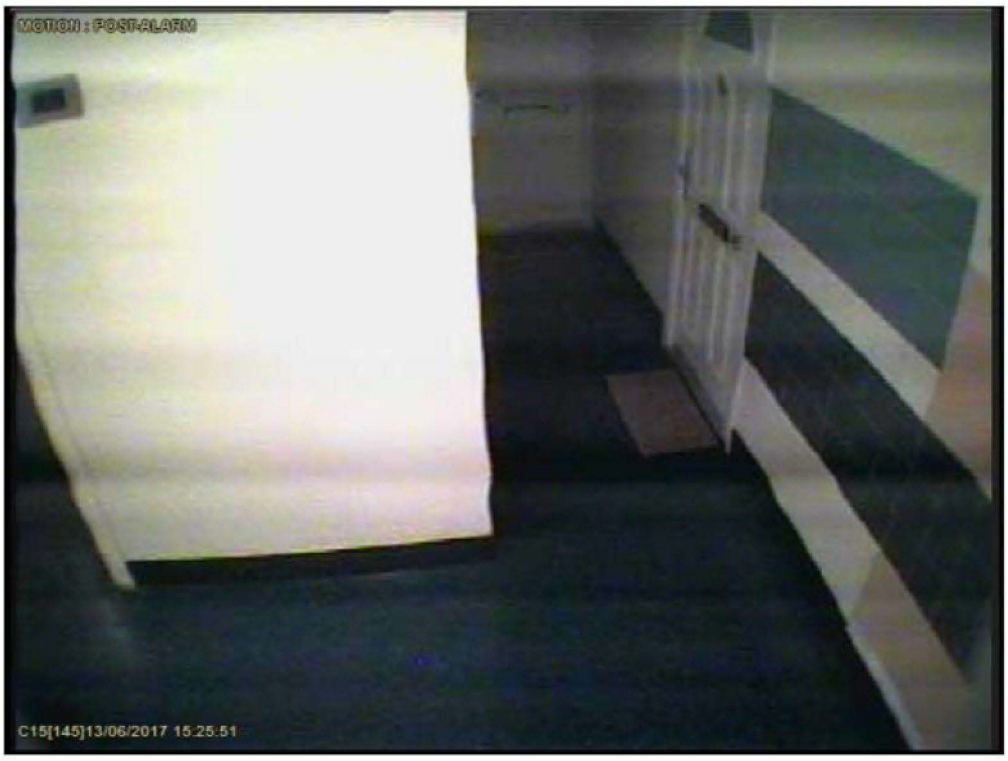


Figure 14.39: Level 7 lobby - Before the fire (MET00012593)

Figure 14.40: Level 7 lobby at 01:40 (MET00012593)

Figure 14.41: Level 7 lobby at 03:00 (MET00012593)

Figure 14.42: Level 7 lobby at 03:36 (MET00012593)

14.6.55 Evidence of damage within the lobbies

14.6.56 I have reviewed evidence from witness statements and from post fire photographs of the lobbies on floors affected by fire to identify, if possible, whether burning items located within the lobbies may have contributed to the conditions experienced by firefighters and escaping residents.

14.6.57 There are 2 key potential sources of fire load in the lobbies:

a) Gas pipes

b) Unauthorised storage of materials

14.6.58 As described in Appendix K (Gas Supply), the building was supplied with gas for domestic use. Flats 1, 3, 4, 5 and 6 on each level were supplied by separate gas risers (1 per flat) passing vertically upward through each flat. These supplies did not interact with the lobbies.

14.6.59 A retrofitted main was installed in the stair with distribution pipes installed in the lobby to serve Flat 2 on the following levels: 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 16, 17 and 21. An example is provided in Figure 14.43.

14.6.60 As described in Appendix K the works to enclose the lateral distribution pipes through the lobbies was started but not complete on the 14th June 2017. Only the Level 5 lateral distribution pipe had been enclosed, on all other Levels the enclosure had not yet been constructed. I have also not found any evidence regarding a fire performance specification for the installed construction. At the time of my inspection there was construction enclosing the lateral gas distribution pipe on Level 5 (Appendix K).

14.6.61 The condition of these gas pipes is currently unknown. It is also unknown if this pipe may have leaked gas into one or more of the lobbies, contributing to the severity of the fire in those locations. This requires expert evidence to resolve.

14.6.62 There is no evidence in the firefighter witness statements reviewed to date of gas fires being observed in lobbies. All references to gas fires identify them occurring within flats for example the following witness statement by Ellis (MET00007693):

Our main issue now with the fires, right up to the stage I left, were that most of the remaining fires in the building were gas fed fires. Where boilers or cookers had been destroyed by the fire, you literally had a gas pipe sticking up with a flame coming out of it in the middle of a room and it would be a desolate room with nothing else left to burn but just the gas flame burning in the middle of the room. We could not knock those fires out because that would cause a gas explosion hazard so the only way forward was to isolate the gas. To facilitate this I committed a crew into the basement to see if we could isolate the gas in the basement as there were some isolation valves in there but that was just at the same time as reports of quite a few really loud banging noises in the building were heard and we thought maybe a few floors are going. Because of this I ordered an evacuation of all personnel from the building and then we were out for some time while we methodically assessed the stability of the building. In the interim the Gas board started digging up the road in three separate places to isolate the various gas supplies to the building. We did try to commit crews again into the basement to isolate the gas but the gas board at this stage and following the previous evacuation of the building did not want to commit staff to the basement of the building.

14.6.63 Please refer to Appendix K where I have presented the evidence from witness statements regarding gas fires within the building in detail.

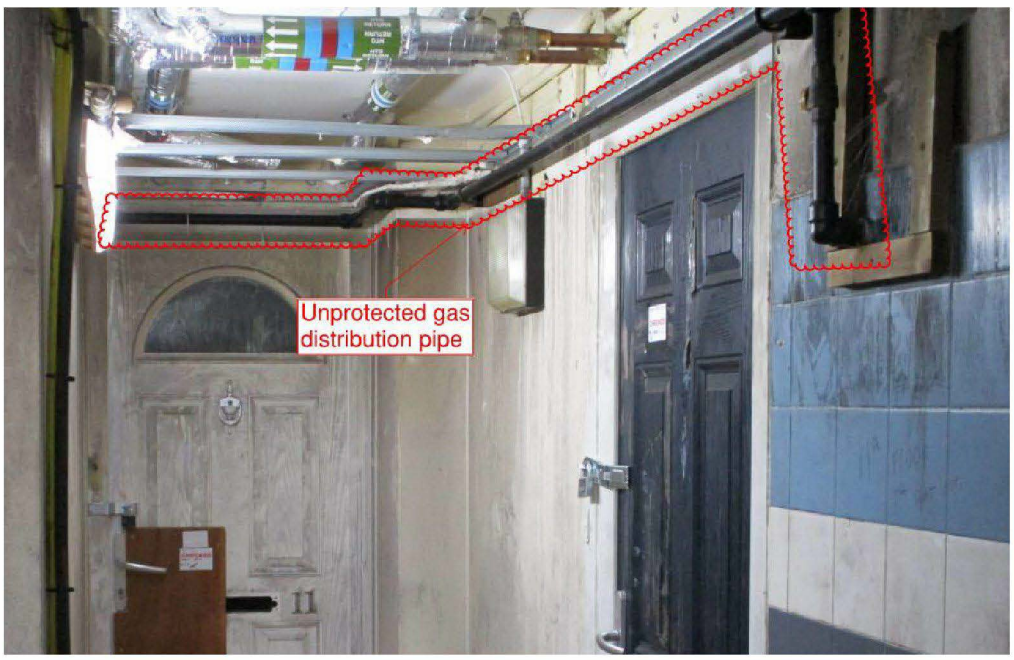


Figure 14.43: Unprotected gas distribution pipe in Level 4 lobby

14.6.64 The MPS took photographs in each of the lobbies immediately after the fire (METS00017072, METS00017081 and METS00019286).

14.6.65 My review of these photographs does not identify substantial evidence of items burning within the lobby. I have also visually inspected each lobby during my post fire inspections in November 2017, as described in Appendix C.

14.6.66 Other than specific internal linings (chipboard, paper on plasterboard, paint, and uPVC door architraves, foam insulation to pipes), which may have been a

minor fuel load for fire in the common lobbies, I have not found evidence of a significant fuel load in the common lobbies. Please see below for specific examples.

14.6.67 Figure 14.44 (METS00016987) and Figure 14.45 (from my post-fire inspection in November 2017) shows the Level 12 common lobby on the south side of the building. The debris present in this image is primarily the remains of the plasterboard ceilings and supports falling from above.

14.6.68 Figure 14.46 and Figure 14.47 show the north and south sides of the lobby (respectively) on Level 13. These photographs were also taken by the MPS immediately after the fire, and show damaged plasterboard ceilings, damaged UPVC door architraves, and damaged riser covers. Two damaged metal chairs are observed in the level 13 lobby, as shown in Figure 14.46.

14.6.69 There is no evidence observed in the MPS photographs reviewed to date that significant fuel load was generally present within the lobbies.

14.6.70 Therefore, most of the heat in the lobbies probably originated from other locations – i.e. from the flats.

14.6.71 Hot gases could enter the lobby from flats through flat entrance doors that were either left open or failed during the fire; I have illustrated this schematically in Figure 14.48.

14.6.72 My post fire inspection identified that the lobbies on levels 1, 2, 3, 4, 6 and 15 did not exhibit damage caused by heat. All other floors exhibited at least one area where the plasterboard ceiling was damaged by heat.

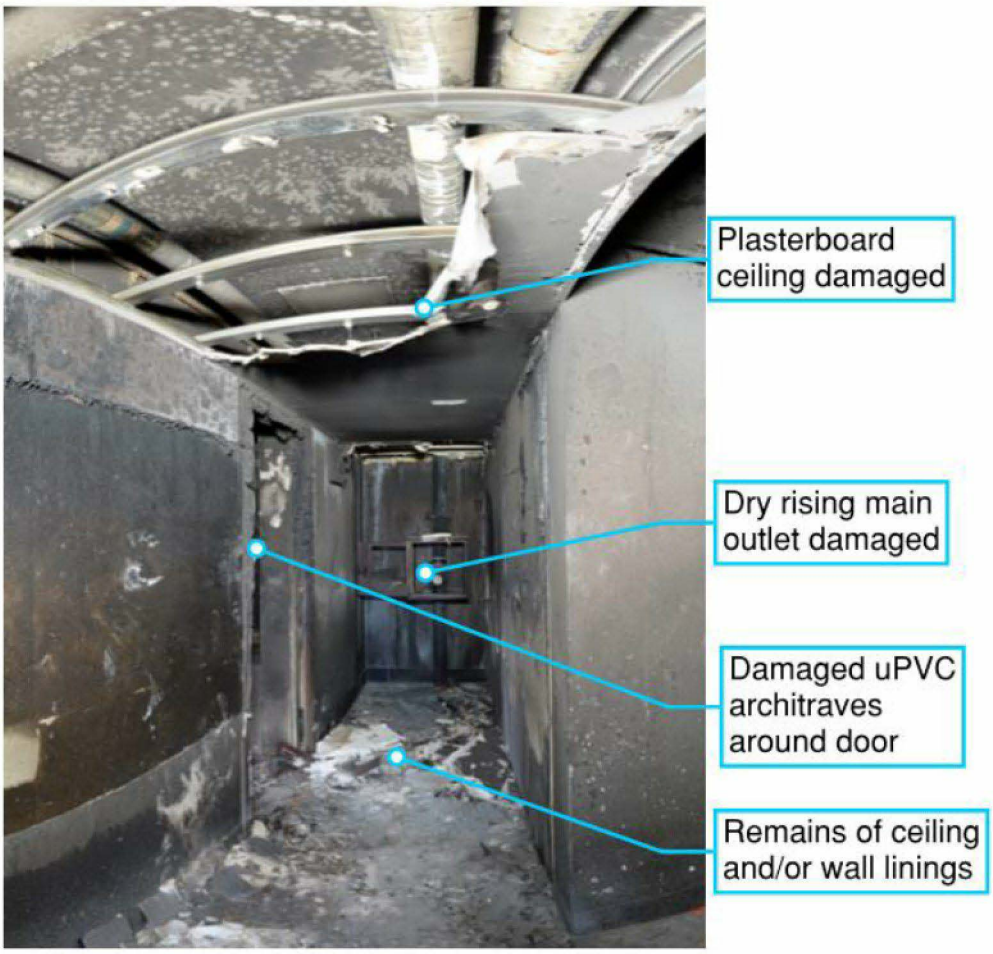


Figure 14.44: Level 12 common lobby (south), photograph taken towards flat 93 (METS00017072)

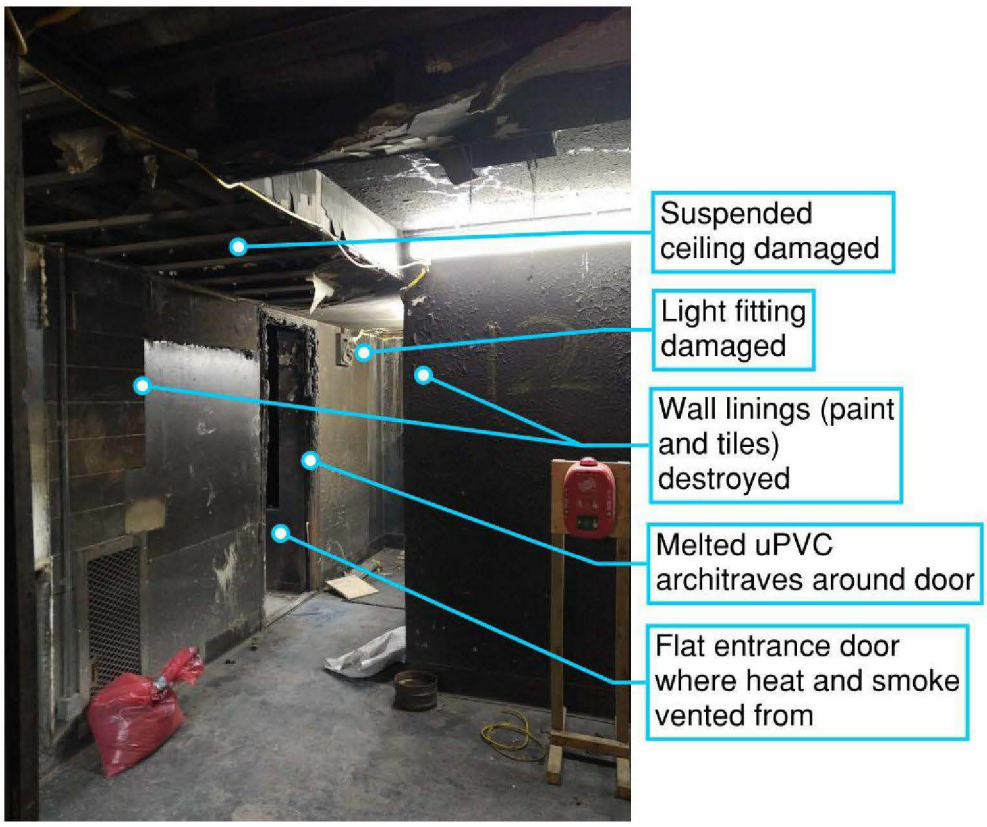


Figure 14.45: Level 12 lobby taken from central portion of lobby

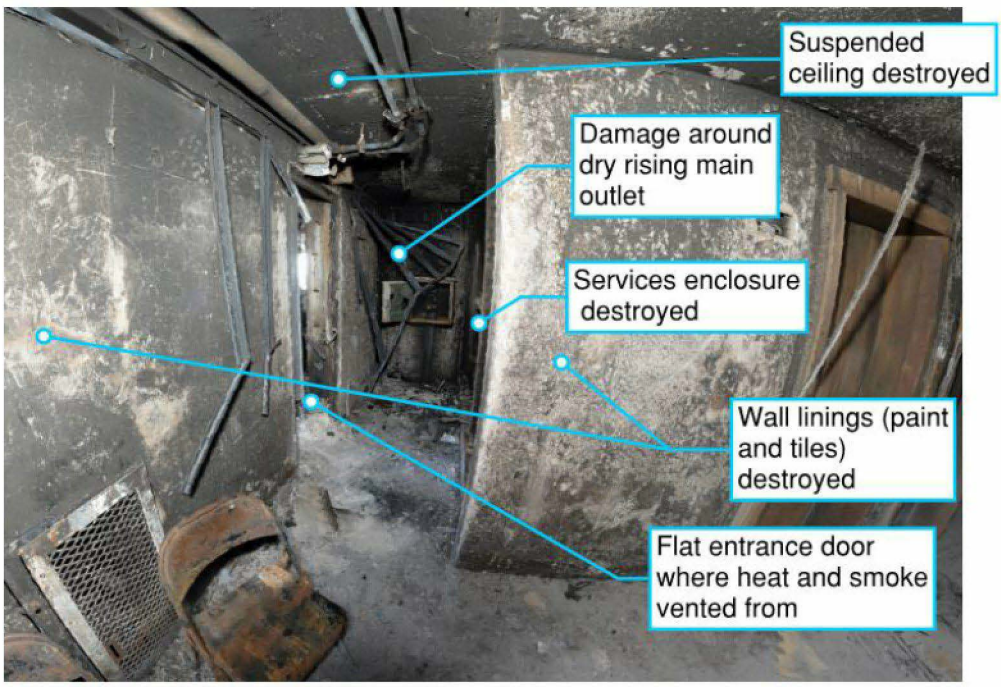


Figure 14.46: Example of how damage caused in lobby by smoke and heat venting from apartments through narrow corridor on Level 13 (South side) (METS00017081)

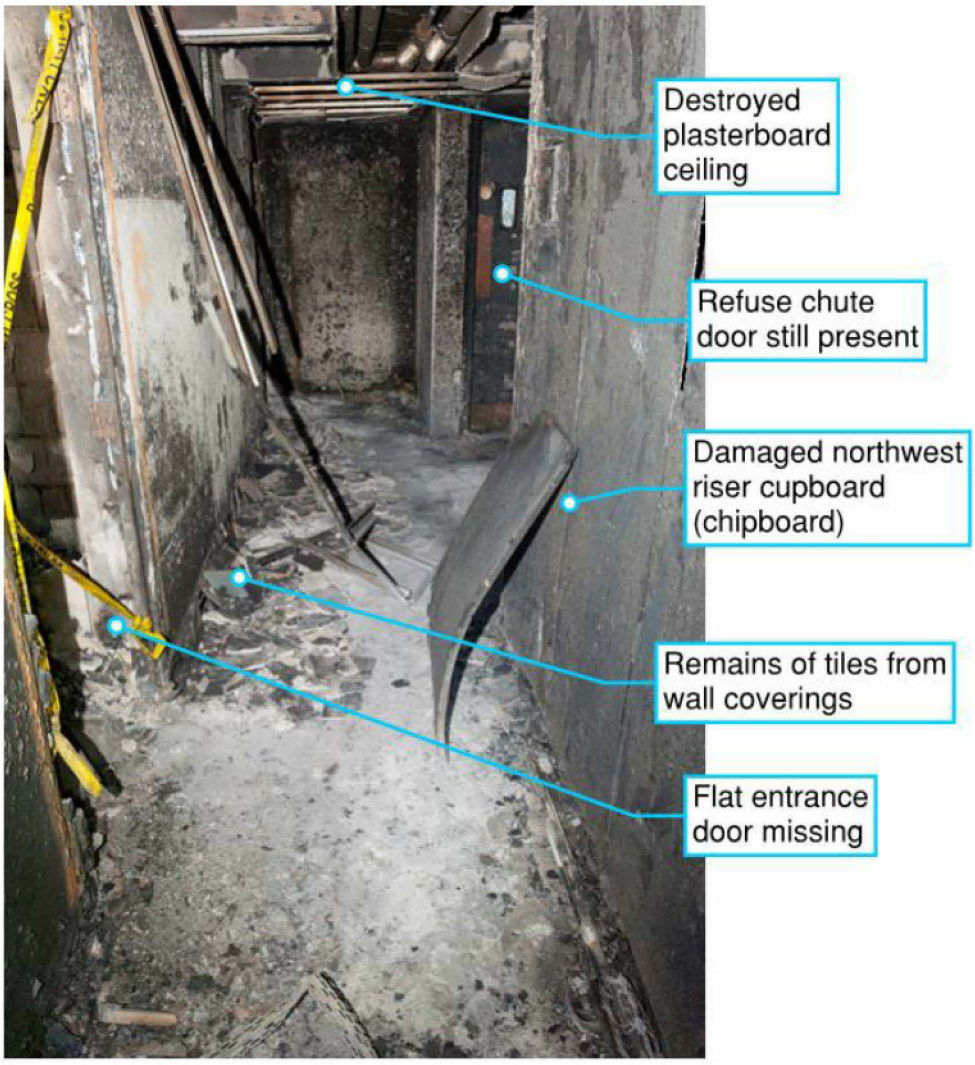


Figure 14.47: Level 13 common lobby (north), photograph taken towards flat 105 and 106 (METS00019286)

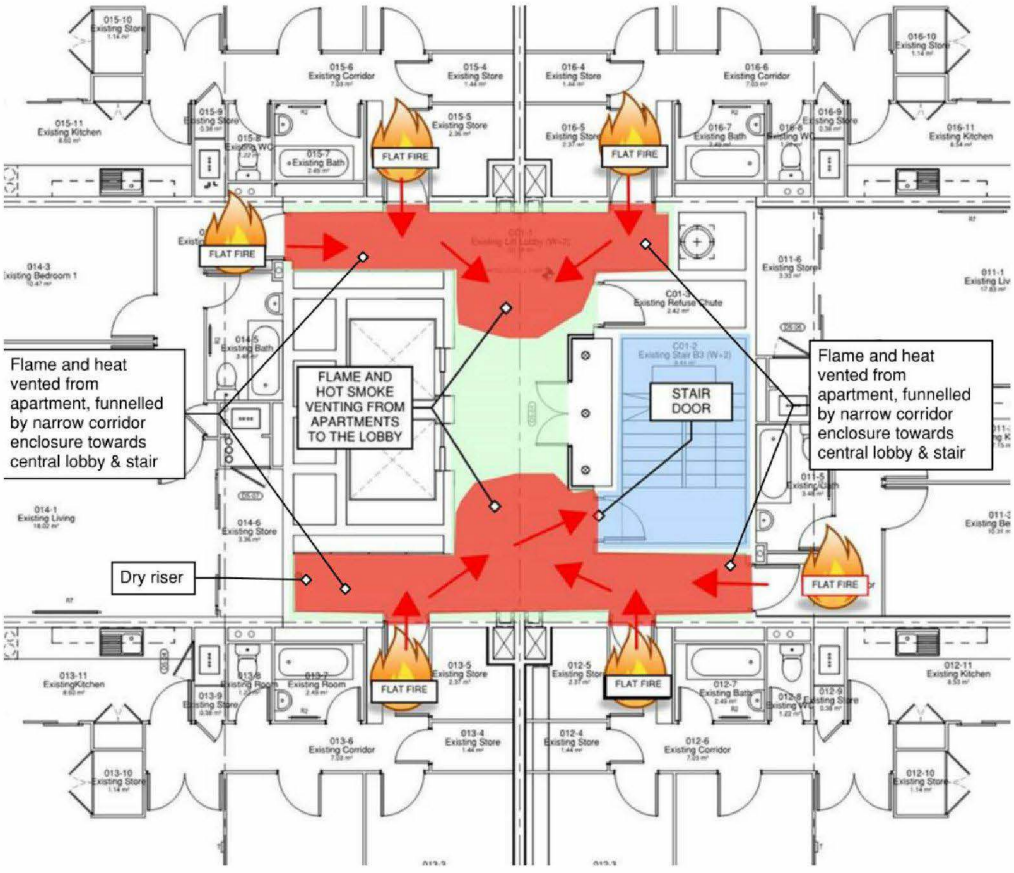


Figure 14.48 Illustration of heat and smoke venting from apartments to the lobby (based on SEA00010474)

14.6.73 I observed severe damage in the narrow corridors leading to the flat entrance doors; I have provided examples for Levels 12, 13 and 16 in Figure 14.49, Figure 14.50 and Figure 14.46. Figure 14.51 shows the conditions in the central portion of the Level 12 lobby.

14.6.74 Figure 14.52 presents an example of damage inside the flat directly in front of the flat door observed in Flat 185 on Level 20 from my post fire inspection.

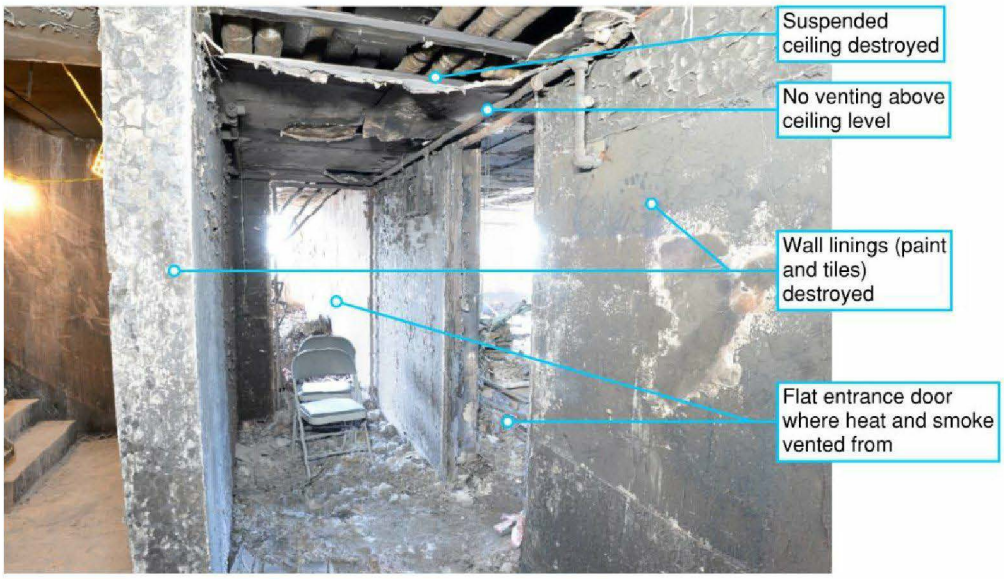


Figure 14.49: Example of how damage caused in lobby by smoke and heat venting from apartments through narrow corridor on Level 16 (South side) (METS00016987)

Figure 14.50: Example of how damage caused in lobby by smoke and heat venting from apartments through narrow corridor on Level 12 (South side) (METS00017072)

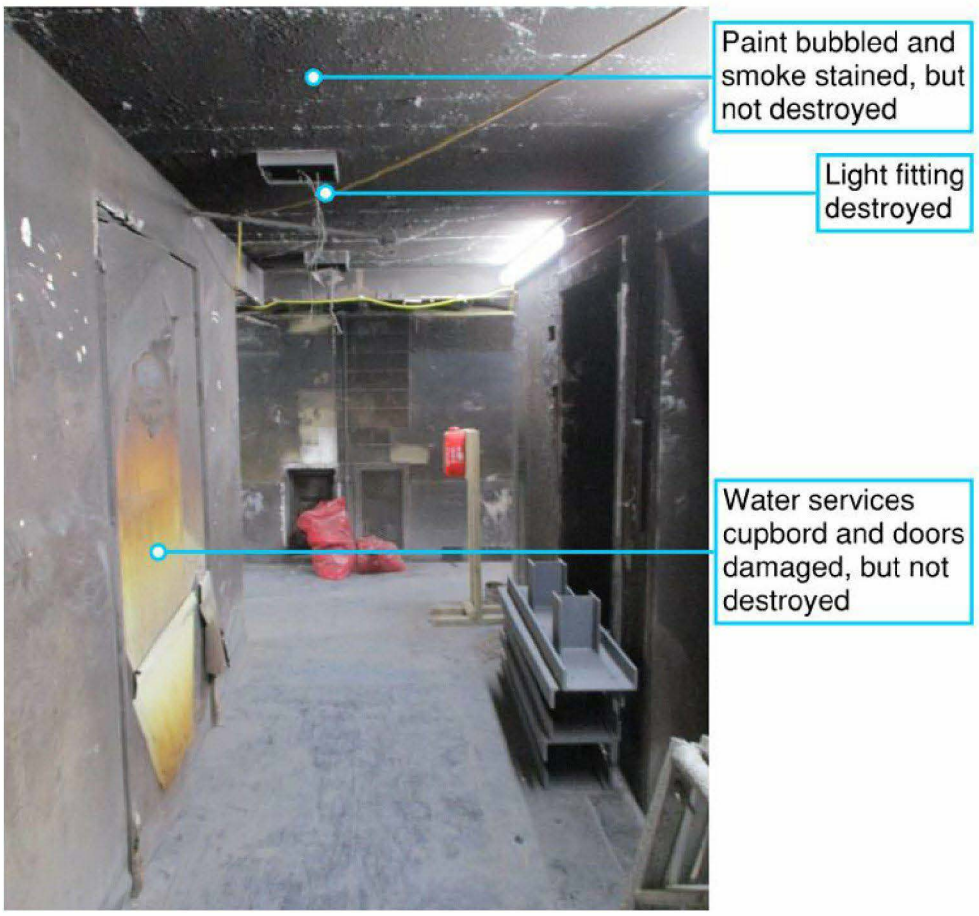


Figure 14.51: Example of post-fire conditions in Level 12 lobby (Central portion)

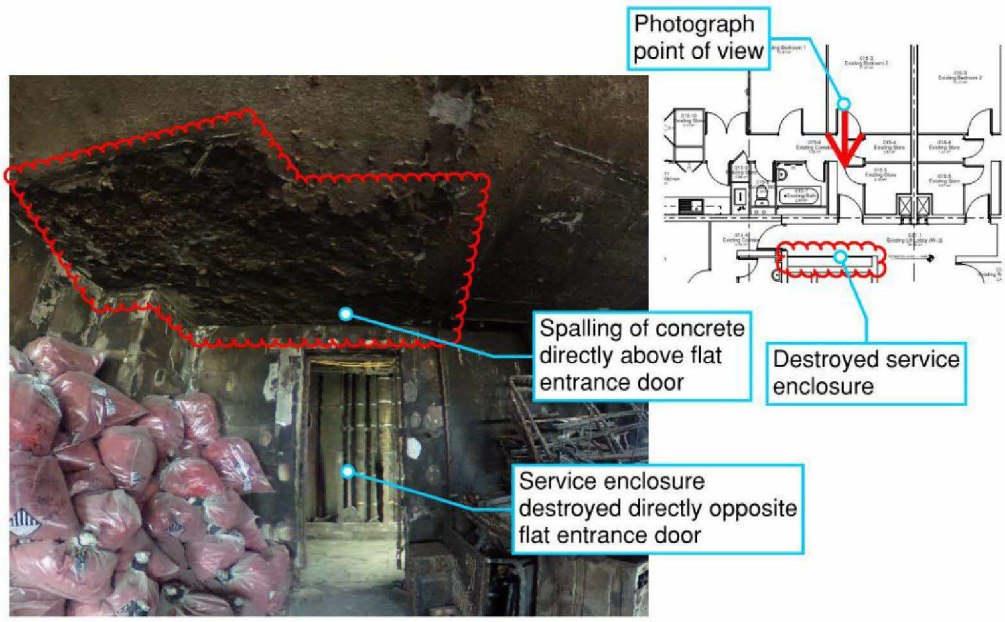


Figure 14.52: Example of damage around entrance door to Flat 175 on Level 20 (post-fire inspection, 08/11/17)

14.6.75 The fire main was also located within these narrow corridors; which sustained heavy damage. I have included in Figure 14.53 an example of the damage sustained surrounding the fire main that firefighters were attempting to access during the fire.

14.6.76 Figure 14.54 shows the dry rising main outlet on Level 14, taken during my post fire inspection. It indicates the damage around the outlet, and a fire hose attached indicating that firefighters attempted to use this outlet at some point during 14th June 2017.

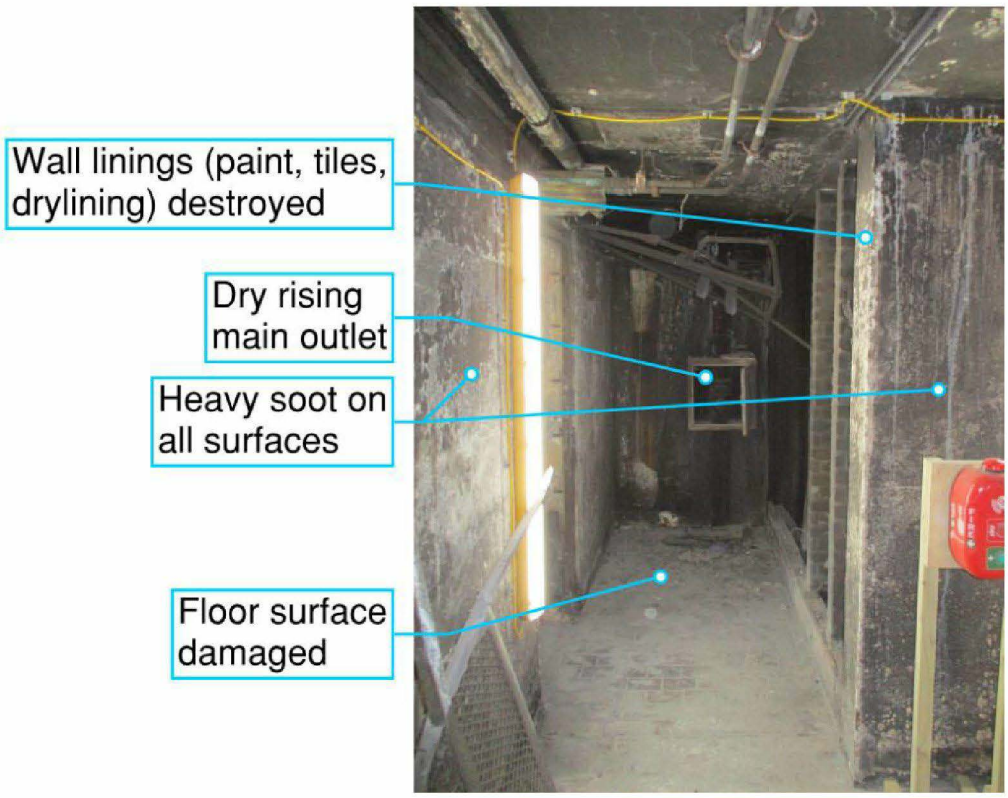


Figure 14.53 Damage surrounding fire main located on Level 19

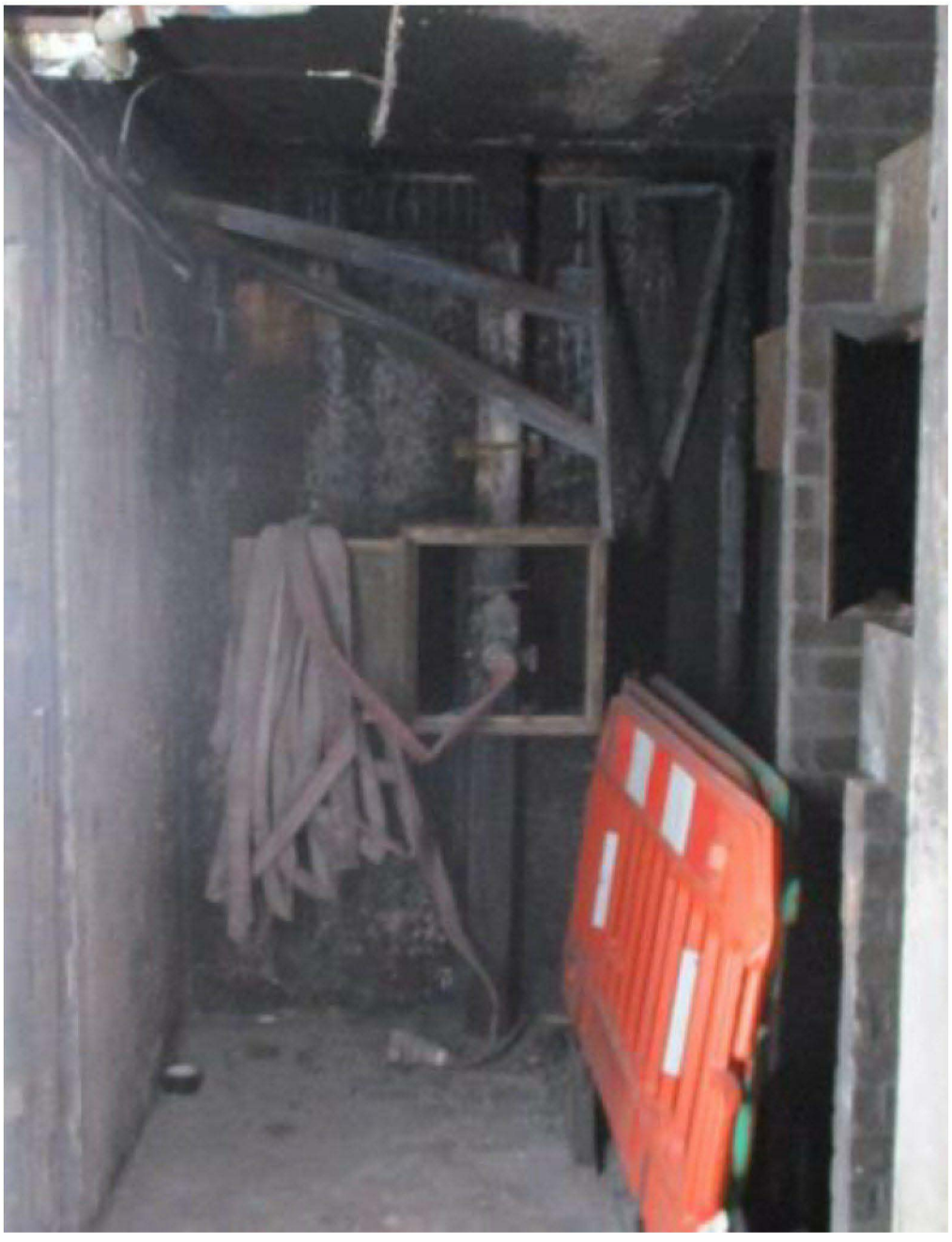


Figure 14.54: Damage around dry rising main outlet on Level 14, where a hose was attached

14.6.77 Other potential vertical routes for fire and smoke spread to the common lobbies include the protected stairway, lift hoist way, refuse chute, and service risers [of which there are multiple].

14.6.78 In my post fire inspection and from review of MPS photographs I have not found evidence that smoke spread to the lobbies from the refuse chute or service risers located within the central core (Figure 14.53).

14.6.79 There is emerging evidence of smoke leakage from the smoke ventilation system on the north and south side of the Lobby which I am investigating at this time.

14.6.80

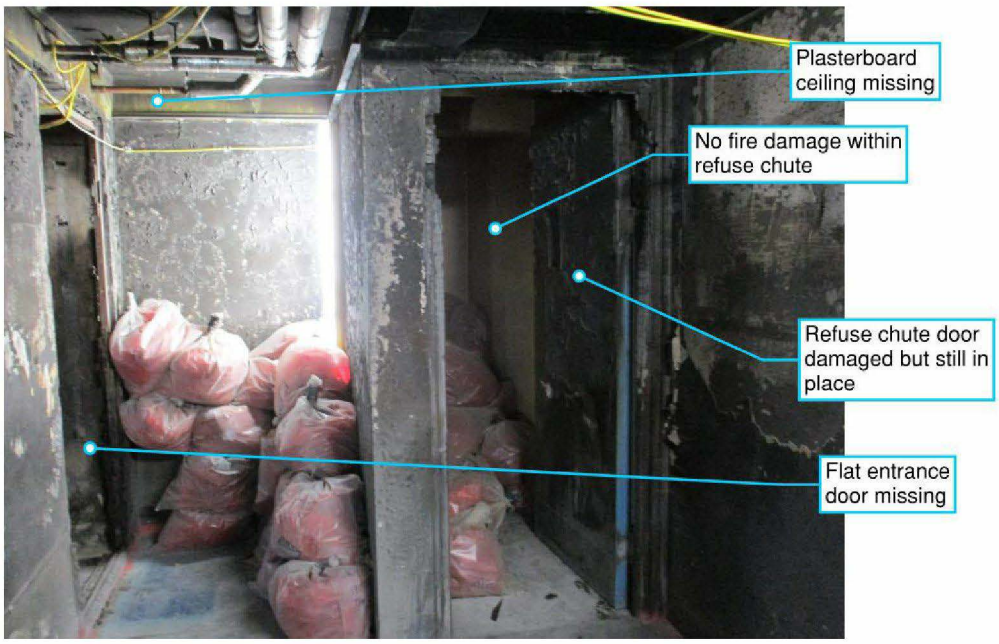


Figure 14.55 Level 10 refuse chute – showing no fire damage within the refuse chute.

14.6.81 **Performance of the protected lobbies**

14.6.82 In this section, I have presented observations from a post fire inspection, and from witness statements of firefighters and residents, regarding the condition of the lobbies in Grenfell Tower on the 14th June 2017.

14.6.83 In summary:

a) Based on witness statements, smoke and hot gasses entered lobbies on several levels of the building early in the fire (i.e. before 01:20) affecting the ability of residents to escape, and of firefighters to conduct firefighting and/or search and rescue operations.

b) There is evidence that the conditions in the lobbies influenced LFB command decisions regarding the position of the Bridgehead and where firefighters could be committed to.

c) There is no evidence of substantial amounts of combustible materials being stored within the lobbies that contributed materially to fire conditions in the lobby.

d) There was no evidence of flame or smoke passage via the refuse chute.

e) The emerging evidence of smoke leakage out of the AOVs in the smoke extract system in the lobbies is of concern but this requires careful

investigation as to the locations, and the potential causes of the leak. However, it is of considerable concern at this stage.

f) The evidence shows that severe heat on lobbies became an issue for firefighters and residents from 02:25. There is evidence of damage caused by fire and smoke in lobbies on all levels between 4 and 23, except Level 6.

g) Between Levels 4 and 17 there are differences in the levels of damage to the lobbies as can be seen in the floor by floor analysis in Appendix C. The common lobbies on levels 6, 8, and 15 are relatively lightly damaged compared to the floors above and below. The common lobby on level 10 is more severely damaged compared to the floors above and below.

h) Damage to the plasterboard ceilings due to heat was identified on all levels for 7 to 23, except Level 15. Noting that the stair door on Level 15 was observed in my inspection to be intact (Figure 14.11).

i) The lobbies on level 18 and above are consistently severely damaged.

j) Damage to north side of lobbies was worse than to the south side on Levels 5, 7, 8 and 9.

k) Fire damage to the lobbies was concentrated around the flat doors, as can be seen in the floor by floor analysis in Appendix C. Smoke and heat from the flat entrance doors was vented to the lobbies, evident from the severe damage in the narrow corridors the doors opened onto.

l) The fire main was located within the narrow enclosure, 5.7m from the stair door (refer to Figure 14.58 Position of fire main relative to stair door on Levels 04 – 23), and directly outside the entrance door of Flat 3 on each level. Therefore, smoke and heat venting from a flat entrance door because of a flat fire, vented directly in front of the fire main. I have recorded severe damage around the fire mains on multiple levels.

m) In the next phase of this investigation I recommend that some consideration is given to the psychological effect on people of smoke filled lobbies as it pertains to their decision to try to escape or to stay in place and await rescue. This includes where smoke had impacted other residents in the lobby or in the stair physically, before any evacuation attempt by neighbouring residents occurred.

14.6.84 Lobby smoke control system

14.6.85 Grenfell Tower was provided with a smoke control system intended to provide protection to the single staircase. Please refer to Appendix J for a full description of the design, programming, commissioning and evidence of operation of the system installed in Grenfell Tower.

14.7 The fire-fighting main

14.7.1 As described in Section 16 and Appendix H, the function of the fire main is to provide a means of conveying water from the fire brigade access level to the fire floor for firefighting operations.

14.7.2 The fire main was located in the lobbies on all levels in Grenfell Tower. On Levels 04-23 it was located 5.7m from the stair door, and directly outside Flat 3, in a relatively restricted branch off the protected lobby.

14.7.3 **Evidence from the post fire site inspection**

14.7.4 During my site inspection I observed a fire main outlet at every level of Grenfell Tower, I have included photographs of a number of levels as an example in Figure 14.56; please refer to Appendix C for further details.

14.7.5 It is not possible to identify from these post-fire inspections which fire main outlets were used during the fire.

14.7.6 The only evidence of hose connection to the fire main I found during my post fire inspection was on Level 14 (see Figure 14.57). It is not possible to determine at what time this was connected or if the hose was used on 14 June 2017.

14.7.7 The damage that I have surveyed in the Grenfell Tower at Level 4 and above provides evidence that, regardless of any fire-fighting undertaken, suppression of the internal fires was not achieved.

a) Ground Level inlet

b) Level 1 Outlet

c) Level 2 Outlet

d) Level 3 Outlet

e) Level 4 outlet

f) Level 9 outlet

Figure 14.56: Example photos of the dry fire main

Figure 14.57 Hose connected to the fire main outlet on Level 14 of Grenfell Tower

14.7.8 Evidence from the firefighter witness statements

14.7.9 As I have shown in Section 13, there was external firefighting water, meaning that water was available at the site.

14.7.10 I have shown in the preceding sections that a fire main outlet was provided on every floor of Grenfell Tower. This fire main outlet was located in the Southwest corner of each lobby, immediately adjacent to the entry door to one of the flats (Figure 14.58).

14.7.11 As I have explained earlier in this section, fires adjacent to flat entrance doors in this location caused venting of fire and smoke into the lobby, resulting in severe damage. I observed this damage on site and there is also support for this in the firefighter witness statements.

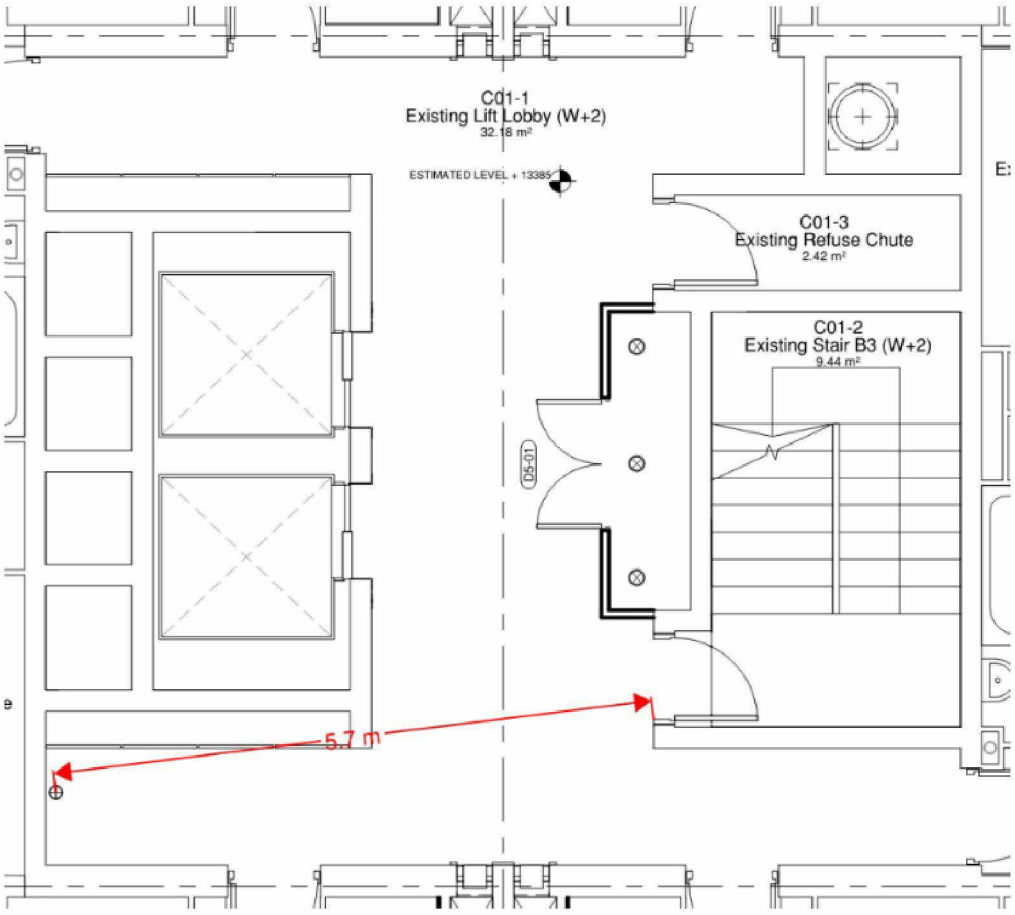


Figure 14.58 Position of fire main relative to stair door on Levels 04 – 23

14.7.12 Firefighters were unable to locate the fire main on floors in which the lobbies were already full of smoke MET00008019, MET00010759

14.7.13 Goulbourne MET00010759

but dissipated. I have provided a sketch to illustrate the floor layout which I exhibit as PAG/3. This shows the position of the risers and explains why we weren't able to access them on many floors. Where all the flats were ablaze it just was not possible to gain access to them which is why we could not get hoses attached.

14.7.14 Eden MET00008019 – 20th floor

I asked Tom if he knew where the dry riser was and he said that he had been told that if you stayed with the wall on the left, when we go in, it would be found. I started following the left wall and almost immediately went back round on myself before coming to a door. I couldn't see anything so had to feel

my way around. I felt a door handle and said to Tom that there was a door and we would come back to it. Distance is hard to tell when you can't see, but I think I we took a few more strides before coming to another door on the left. I was thinking that the dry riser must be here somewhere and I was searching the whole wall up and down - down to the ground and up as high as I could reach, but I couldn't find it. I said to Tom that I couldn't find it and asked if knew exactly where it was. He said that he was told to stay on the left and we'll find it. I had walked back towards him a little bit to talk to him as sound doesn't travel very well in a smoky environment and it was hard to hear each other. We carried on a bit further and came to a third door and then there was a wall at the end, which went round to the right. As we turned round to the right again, I then felt the dry riser in its box, which was in front of me. I bent down and got up close to it, turned my torch on and saw that it was locked. I shouted to Tom that I had found it and told him to get the branch so I could smash the glass. I queried with Tom about why the dry riser wasn't out in the hall or in a protected area where it ideally should be and thought how crap it was, where it was placed. The placement of the dry riser in the lobby was a risk to fire fighters as if there had been a fire in the lobby area, we wouldn't have had any water to get in there safely. I would expect it to be in a protected stairwell or behind fire doors but assume that it was where it was because Grenfell was built before the change in fire regulations. I then turned the dry riser on to see if any water came out, which it did and I

14.7.15 Goulbourne MET00010759

We were still using the outlet risers on floors 3 and 4 so we used extension hoses to allow the fire to be fought higher up. This allowed the hoses up as far as floor 7/8. This mean that everything was protected up to the 6th floor but I wanted to get another extended jet: We couldn't achieve this however because the whole of the outside of the building was alight, debris was falling and it was impossible to get a crew in to achieve it.

14.7.16 **Performance of the firefighting main**

14.7.17 The following witness statements indicate that the dry main operated in the lower portions of the building during the early stages of the fire.

14.7.18 Before 02:00 there is evidence of the dry rising main being used successfully up to Level 9.

14.7.19 Batterbee reports being able to operate the dry main successfully on the 4th floor when committing to the initial fire in Flat 16 (MET00005674).

14.7.20 Batterbee MET00005674:

Once on the fourth floor we met with FF Dorgu and CM Secrett, visibility was very good. I checked the door with the thermal imaging camera, whilst I cant remember the temperature, I can confirm that I didn't identify it as being hot. We then started flaking the hose out according to the floor layout whilst waiting for water on. Once the line was charged I had another look with the TIC, again, I didn't notice any readings that would concern me. I then carried out a wet test on the door there was no steaming off.

We then set our positions and made entry. I was on the branch and FF Brown put the door in with one hit of the enforcer. He then got straight down behind me with the TIC. I put a long pulse in and didn't notice any adverse effects. It was a warm night and I was getting warmer because of the

14.7.21 Batterbee MET00005674

> I started to extinguish fire and knocked it right out, I then aimed the jet out of the window and used it to draw the smoke out, this worked well and we could then see clearly and it was cool enough for us to stand up. We took and quick gauge reading and I handed the branch to FF Brown so I could get a message to Alpha control to update them. We then noticed that there was flame outside the window above room we were in. FF Brown started hitting it with the jet and it was having no effect.

14.7.22 Nelson (MET00007785) also reported "*no difficulty with water pressure*" on the 9th floor at approximately 02:20:

> On floor nine (9) I believe there to be three (3) or four (4) flats in total. Following the residents leaving via the stairwell we then began knocking on other doors. I saw smoke coming from the door of Flat sixty six (66). The door was then forced by colleagues and I had the 'branch' meaning the leading person with the hose, so led the way into the flat with the hose which had been attached by another colleague. The hose was approximately twenty five (25) meters long and I did not notice any difficulty in water pressure. I progressed into the flat but it was already significantly consumed by fire. I let out safety shots of water in order to attempt to cool the air down around us to try and enable us to proceed. This was not making

14.7.23 At 02:10 Eden (MET00008019) was able to connect to the fire main on Level 20, however the water pressure and flow was not forceful and insufficient to open the hose.

14.7.24 Eden MET00008019

> change in fire regulations. I then turned the dry riser on to see if any water came out, which it did and I then attached the hose. Tom took the other end of the hose and started to unroll it and put the branch in the end. I turned the water back on and could feel the hose filling up but Tom said there was no water. We didn't have a lot of room to throw it out so had to pass it out by hand and it now obviously had a kink in it. The water pressure would normally open up the hose, but it wasn't very forceful so we had to fiddle around with it until the kinks were straightened and water started to come out of it and it was knocked off.

14.7.25 Between 02:00 and 05:00 fire crews are reported in the decision log of AC Roe (MET00005404, excerpt below) as being present on floors up to Level 12:

> MM: resources update – currently using 20 x EDBA & 15 SDBA per hour. EDBA on 11th and 12 floors. SDBA on 6th and 7th floors.
> PPV – Nic Harding. 7th & 8th floor ALP may not be achievable.
> CU staff report building plans should be in fire box in lobby.

14.7.26 With the information currently available, I have not been able to confirm which, if any, of these crews may have been operating, or trying to operate hoses from the dry rising main.

14.7.27 In the later stages of the fire, when there were systematic firefighting operations on multiple floors and multiple hoses were in operation at any one time, water flow and pressure was described as limiting firefighting operations.

14.7.28 Specifically, Roe (MET00005404) identifies that there was no water above Level 14 at 05:50. The restriction to prevent firefighters going to floors above Level 12 was therefore retained at this time, and this continued to at least 06:10.

14.7.29 Roe MET00005404:

> 05:50
> Tom Goodall: Wet riser is poor and supply is being augmented LPP from 6th floor. Crews committed with limited weight of attack and crews above fire close to life risk.
>
> 05:50
> Tactical Coordination Meeting – Sit rep. LFB – No change. Crews up to 14th floor. Dangers for our crews. No water – there may be a decision to not commit above 14th due to risk.
>
> Andy Roe: Decision @ 06:10 No ops crews beyond 12th floor. Availability of water and advice from sector. No water above and confirmed not cleared yet.

14.7.30 It should be noted that LPP is a lightweight portable pump.

14.7.31 Access above Level 12 was permitted after 07:08 when additional water supplies had been secured.

> 07:08
> Andy Roe – spoken with Ops Commander & Sector Commanders. Improved water supply achieved with intention of improving on initial target of beyond 12th floor.

14.7.32 Goulbourne (MET00010759) and Graham (MET00005257) identify that additional water supplies were provided in the form of lightweight pump sets and additional hose lines laid in the stair.

14.7.33 Goulbourne (MET00010759)

> At some point we managed to get hoses attached to the risers on floor 9 and so the EDBA crews were firefighting on those floors. In addition we had managed to get a further two hoses into the building and up the stairwell via a lightweight pump at the front and a pump at the back. The fire on floor 11 was fierce, horrific.

14.7.34 Graham MET00005257

> *Additional problems with hose build up in upper floors restricting access past the 12th and of course the severity of the conditions from the fire all impeded progress. At one point I ordered all Personnel down to the bridge head and completely relayed and removed the old hose. I then had a single length and branch on floors 6 to 12 to control fires on each of those floors and instructed that under no circumstance were those hose lines to enter the staircases. We ran a new line up the stairs and bought in an additional light weight pump and had it placed on an upper floor to allow increased water pressure and ran that length to reach passed the 15th floor.*

14.7.35 Additionally, George stated that water supplies above the 11th floor at approximately 13:00 were being limited by the tender pump operation, requiring the tender pump operating pressure to be increased.

14.7.36 Ogden (MET00007657) reported around 16:00 the water was switched off *"in order to re map the hoses in to the building for a more efficient way to fight the fires that were still in progress"*.

14.7.37 Figure 14.59 summarises the levels on which successful or unsuccessful fire main operation was recorded over the course of the 14 June 2017. It also illustrates the recorded level of the Bridgehead (Section 14.4.110) at that time.

14.7.38 Figure 14.59 also illustrates that crews were attempting to operate the fire main up to 18 stories above the Bridgehead location. This is significantly greater than the typical 2 stories I described in Section 14.2.

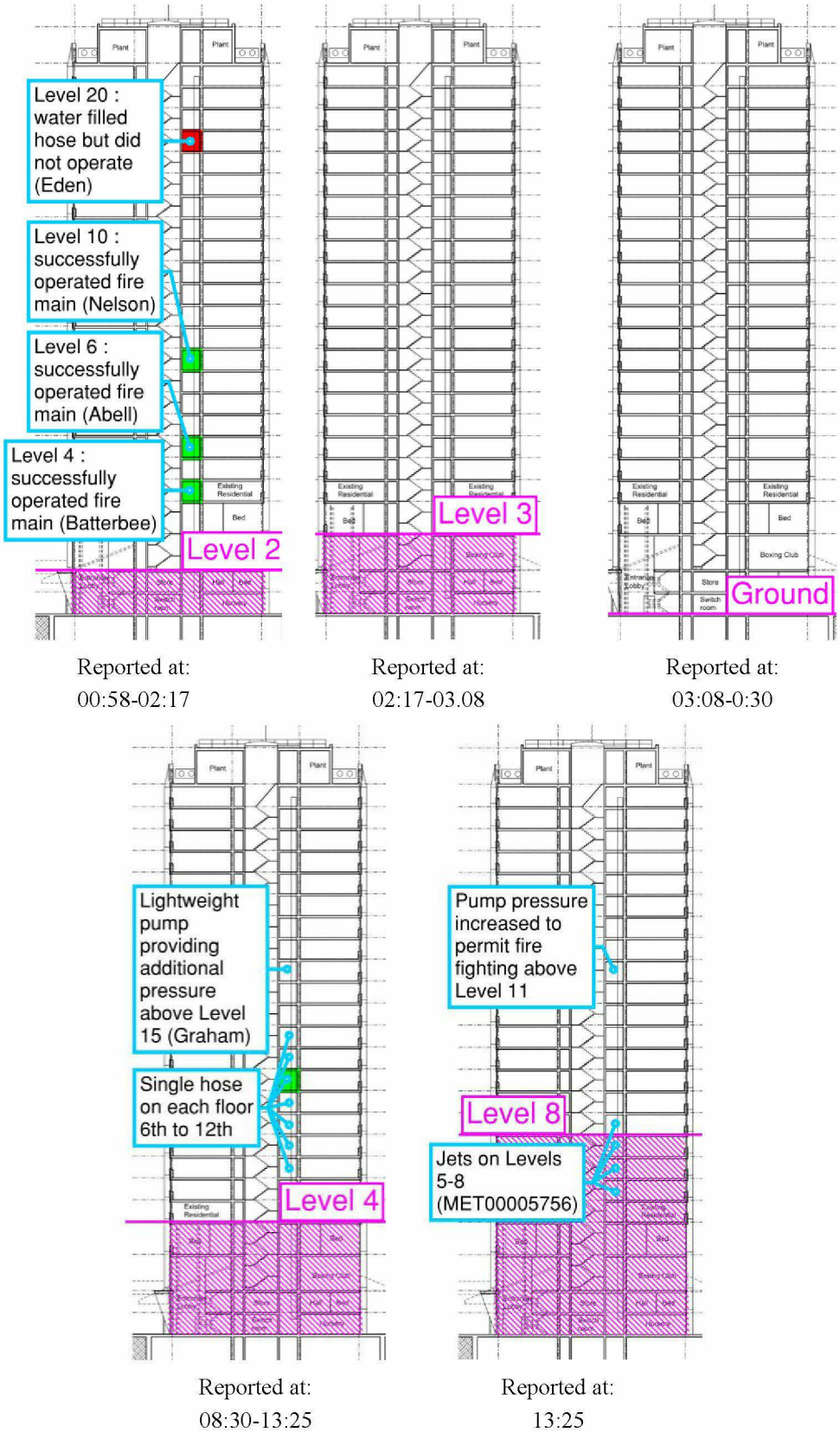


Figure 14.59 Evidence related to dry main operation during 14 June 2017 relative to the Bridgehead location (SEA00009461)

14.7.39 Therefore, the evidence I have seen indicates:

a) The firefighters had difficulty finding the dry fire main due to its position in the lobby at the most remote point from the stair and the lack of visibility and heat in the lobbies (MET00008019, MET00010759).

b) Firefighting water flow pressure was available prior to 02:00 as high as Level 09. At around the same time insufficient water flow and pressure was available to crews who had reached the higher levels of the building (Level 20) (MET00005674, MET00007785, MET00008019).

c) At a later stage of the fire, when there is evidence of hoses being used on multiple floors simultaneously, there was insufficient pressure to provide water above levels 12 – 14. Lightweight portable pumps were used to 'augment' the supply of water to the upper levels' (MET00005404). Eventually water is described as being supplied to At least Level 15 (MET00005257).

14.8 The fire-fighting lifts

14.8.1 During my site inspection, I observed a fire-fighting switch for the lifts at ground floor level and at Level 2 (Figure 14.59).

14.8.2 I also observed the lift car of one lift to be located at Level 10 (also Figure 14.60).

14.8.3 At this time, I have found no evidence to indicate that only one lift was intended to operate as a fire lift, therefore in my investigation I currently consider both lifts to have been intended as fire lifts. When further evidence regarding the design, installation and maintenance of the lifts I may be required to revise this assumption.

14.8.4 I have presented all the evidence and my opinion regarding the Lifts in Appendix L.

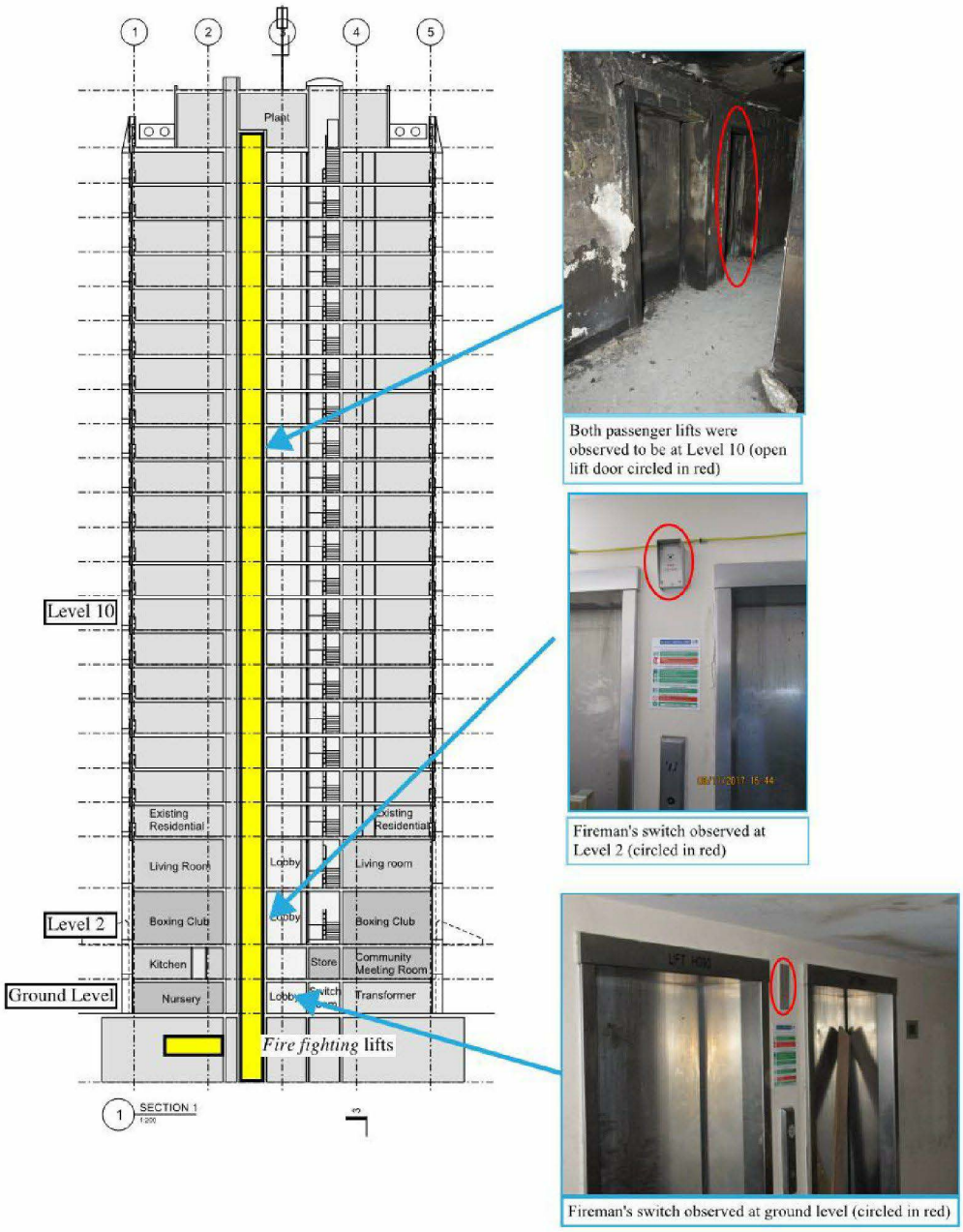


Figure 14.60 Site inspections findings with respect to the position of the lift cars in Grenfell Tower. (SEA00009461)