

**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 1

Introduction and chapter index

REPORT OF

Dr Barbara Lane FREng FRSE CEng

Fire Safety Engineering

24th October 2018

Specialist Field	:	Fire Safety Engineering
Assisted by	:	Dr Susan Deeny, Dr Peter Woodburn, Dr Graeme Flint, Mr Tom Parker, Ms Danielle Antonellis, Mr Alfie Chapman
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 14 th June 2017
Inspection Date(s)	:	6 th October, 1 st November, 7-9 th November 2017

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1 Introduction

1.1 Formal Details

- 1.1.1 I am Dr Barbara Lane. I am a Director of Arup, and a member of the UK Middle East and Africa Board, within our Global Group structure. I am Group leader, an operational role, of the Advanced Technology and Applied Innovation Group in the UK. Arup is an independent company of designers, planners, engineers, consultants and technical specialists offering a broad range of professional services in the Built Environment. Arup is located at 13 Fitzroy Street, London, W1T 4BQ.
- 1.1.2 I am a Chartered Fire Engineer. I was made a Fellow of Arup in 2012 - a life-long, honorary title awarded to exceptional individuals in the firm considered role models with world-class vision and initiative. I specialise in fire safety engineering in the Built Environment. This includes during the design, construction and operational stages. My experience over the last 21 years incorporates specific experience on matters such as the consideration of regulatory compliant fire safety design and construction solutions, the performance and testing of construction materials in fire, and the handover process including cause and effect testing of fire safety systems, management duties, and handover documentation.
- 1.1.3 I was made a Fellow of the Royal Academy of Engineering in September 2016. The citation prepared by the selection committee states: “... *for crystallising fire safety engineering as a profession by immersing it in the field of building design and construction... [and integrating] it with other disciplines by incorporating structural engineering into fire analysis, and driving competence, education, regulation and stakeholder relationships.*” They additionally stated how I was also one of the first to: “*study, develop and bring to practice the explicit coupled analysis¹ of structures and fire - generating methods that migrated from science to the mainstream...*”
- 1.1.4 In Appendix A, I have provided my CV, which contains further details of my experience, qualifications, appointments and specialist fields.
- 1.1.5 I was assisted in preparing my report by my colleagues at Arup, Dr Susan Deeny, Dr Peter Woodburn, Dr Graeme Flint, Mr Tom Parker, Ms Danielle Antonellis, and Mr Alfred Chapman. Their CVs are provided in Appendix A.
- 1.1.6 I was assisted in my investigations on site by some of those colleagues too but additionally, Mr Joe Wade, Mr Conor Hoey, Mr Roy Little, Mr Marc Pawson, Mr Angus Elliott, and Mr Albert Voet. See Section 6 of my Expert Report.
- 1.1.7 However, this report, and the analysis and views expressed in this report, are my own.

¹ An advanced numerical model of the impact of heat from a fire, on complex structural stability systems.

1.2 Synopsis

- 1.2.1** The Government has set up an independent public inquiry into the fire which occurred on the 14th June 2017 at Grenfell Tower.
- 1.2.2** The Inquiry will examine the circumstances leading up to and surrounding the fire at Grenfell Tower on 14th June 2017. It will establish the facts and will make recommendations as to the action needed to prevent a similar tragedy happening again.
- 1.2.3** The Inquiry will be independent.
- 1.2.4** The Inquiry's Terms of Reference are:
1. To examine the circumstances surrounding the fire at Grenfell Tower on 14th June 2017, including:
 - a) the immediate cause or causes of the fire and the means by which it spread to the whole of the building;
 - b) the design and construction of the building and the decisions relating to its modification, refurbishment and management;
 - c) the scope and adequacy of building regulations, fire regulations and other legislation, guidance and industry practice relating to the design, construction, equipping and management of high-rise residential buildings;
 - d) whether such regulations, legislation, guidance and industry practice were complied with in the case of Grenfell Tower and the fire safety measures adopted in relation to it;
 - e) the arrangements made by the local authority or other responsible bodies for receiving and acting upon information either obtained from local residents or available from other sources (including information derived from fires in other buildings) relating to the risk of fire at Grenfell Tower, and the action taken in response to such information;
 - f) the fire prevention and fire safety measures in place at Grenfell Tower on 14 June 2017;
 - g) the response of the London Fire Brigade to the fire; and
 - h) the response of central and local government in the days immediately following the fire; and
 2. To report its findings to the Prime Minister as soon as possible and to make recommendations.
- 1.2.5** As part of the call for evidence for this Public Inquiry, expert witnesses have been instructed to assist the Inquiry.

1.2.6 The expert witnesses are to provide a range of technical advice and expert reports to assist the work of the Inquiry in delivering against its Terms of Reference.

1.2.7 On the 16th November 2017 I was instructed as an Expert Witness to the Public Inquiry.

1.3 Chapter index

Section 1

Introduction and chapter index

Section 2:

Issues, Summary, Conclusions and Next Steps

Section 3:

Building description and fire safety requirements; key definitions including relevant test evidence

Section 4:

Overview of building works at Grenfell Tower, including recent refurbishment 2012-2016

Section 5:

The observed events of 14th June 2017

Section 6:

Investigating how this happened – the physical evidence at Grenfell Tower

Section 7:

How and where the fire started

Section 8:

The external wall – materials and construction

Section 9:

Routes for fire spread out through the window openings

Section 10:

Routes for vertical and horizontal fire spread throughout the building envelope

Section 11:

Construction of the external walls – the provisions made at Grenfell Tower to comply with Building Regulations

Section 12:

The significance of the building envelope fire

Section 13:

Critical times during the fire event

Section 14:

The performance of the protected stair and lobbies

Section 15:

Construction of the common lobbies – the provisions made at Grenfell Tower to comply with the Building Regulations

Section 16:

Construction of the single protected stair – the provisions made at Grenfell Tower to comply with Building Regulations

Section 17:

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Section 18:

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Section 19:

How the protected stairs and lobbies failed for the residents and fire fighters

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Section 21:

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Appendix A:

Experience, qualifications, appointments, speciality of the Expert and of those who have assisted in the preparation of the report

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Appendix C:

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Appendix D:

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Appendix E:

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Appendix I:

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Appendix L:

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Appendix N:

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1.4 Disclosure of Interests

- 1.4.1** I have over the course of my 21-year career as a fire safety engineer at Arup, had various technical reasons on my projects, projects for other employees of Arup, and through my own research work, to interact with personnel from DCLG (now MHCLG), Kingspan, Celotex, NHBC, RBKC, LFB, Max Fordham, Siderise, SiG, BRE, Exova Warrington fire, Professor Bisby, Professor Torero, Professor Galea. All of these organisations and individuals are referred to herein.
- 1.4.2** I have worked on projects or reviewed projects where the building envelope contained combustible materials in that 21-year period.
- 1.4.3** I have since 2014, in public, expressed concerns regarding combustible insulating materials used in building envelopes. I have previously shared those concerns with the BRE, the DCLG, NHBC and Kingspan, and also via various public speaking engagements.
- 1.4.4** Other Arup staff have also given presentations on the subject of fire safe facades, and entered into discussions as a result, explaining those views, with companies such as Booth Muir, one of the producers of ACP panels in this country. Booth Muir, are wholly owned by Kingspan Group Ltd.
- 1.4.5** At the request of London Fire Brigade, I spent a few hours around the Grenfell Tower site (not in the building) late afternoon/evening on Wednesday the 14th June providing technical guidance to London Fire Brigade in their Command Unit, regarding potential structural fire collapse scenarios.
- 1.4.6** On the 16th June 2017, Arup was appointed by the Royal Borough of Chelsea and Kensington (RKBC), to provide technical support to James King of Harrow Building Control. This consisted of advice regarding the post-fire structural stability of Grenfell Tower, during body recovery only. Our involvement is now complete.

- 1.4.7 I spent the entire day of Friday the 16th June around the site, outside the building only, again providing advice regarding post-fire structural stability. On that day I was in the company of Mr John Allen, Building Control officer, from RKBC. Various firefighters from London Fire Brigade, members of the Metropolitan Police Service, and a representative of the HSE, were also in my presence at times throughout that day also, as were two other members of Arup staff.
- 1.4.8 Arup was also appointed by RKBC, immediately after the Grenfell Tower fire, to carry out an audit of the compliance status of the Kensington Row high rise residential building. Our involvement is now completed.
- 1.4.9 I am a post-graduate of Edinburgh University where I studied under the supervision of Professor Dougal Drysdale.
- 1.4.10 I was a Visiting Professor at the University of Edinburgh for over five years. I resigned when I was made aware that academic staff at the University were interacting with the BRE on Grenfell-related fire safety matters. These staff work at the *The BRE Centre for Fire Safety Engineering* at the University of Edinburgh. My own work at the University involved the supervision of Arup funded PhD students, an annual research planning meeting regarding research for Arup projects, the occasional undergraduate lecture for recruitment to Arup, and the funding of an Arup Professor of Structural Fire Engineering.
- 1.4.11 In my investigation of the facts and in expressing my opinion herein, I don't consider these interactions to have caused any actual or potential conflict of interest.
- 1.4.12 Regarding my assistants, I describe their interests as follows.
- 1.4.13 Dr Deeny, completed her PhD (2006-2010) within the *The BRE Centre for Fire Safety Engineering* at the University of Edinburgh.
- 1.4.14 In the course of her 8-year professional career as a fire safety engineer she has had various technical reasons on her projects and through Arup's external research activities to interact with personnel from *The BRE Centre for Fire Safety Engineering*: Professor Luke Bisby (Expert to the Inquiry), Professor Jose Torero (Expert to the Inquiry) and Dr Rory Hadden (MPS Forensic Expert Review Group (FERG)). Professor Torero no longer works from the University of Edinburgh.
- 1.4.15 Dr Flint is a graduate of the University of Edinburgh. In addition, he has over the course of his 11-year career as a fire safety engineer at Arup had various technical reasons on his projects, projects for other employees of Arup, and through his own research work, to interact with personnel from Kingspan, Celotex, RBKC, NHBC, LFB, Max Fordham, Siderise, BRE, Exova Warrington fire, Professor Bisby, Professor Torero. All of these organisations are referred to herein.

- 1.4.16** During his time as a professional engineer he has worked on projects or reviewed projects where the building envelope contained combustible materials.
- 1.4.17** As part of his graduate training at Arup he undertook a 10-week placement with the London Fire Brigade Fire Engineering Group.
- 1.4.18** He assisted me when advising RBKC on the 14th June 2017 and over the following weeks, regarding the structural stability of Grenfell Tower in the aftermath of the fire.
- 1.4.19** Dr Peter Woodburn has been involved in Fire Engineering and Fire Science since 1990. He was professionally employed by Atkins, Halcrow (CH2M Hill) and since April 2015 by Arup as a fire safety engineer.
- 1.4.20** He was employed by the Civil Engineering Department, University of Edinburgh as a Research Associate in fire engineering over the period 1995-1996.
- 1.4.21** In his professional career he has interacted with London Fire Brigade on several projects.
- 1.4.22** During his employment at Arup he has undertaken liaison with University of Edinburgh on research at the University funded by Arup, including Arup-funded PhD students.
- 1.4.23** Dr Woodburn assisted me when advising RBKC on the 14th June 2017 and over the following weeks, regarding the structural stability of Grenfell Tower in the aftermath of the fire.
- 1.4.24** Mr Joseph Wade is a graduate of the University of Portsmouth with over 20 years in the building services industry.
- 1.4.25** Over the course of his career he has had various technical reasons on his projects to interact with personnel from BRE, Exova, Warrington Fire, Kingspan, Belimo, Elta and Gilbert. All of these organisations are referred to herein.
- 1.4.26** Mr Wade has assisted me with regard to the operation of the building services.
- 1.4.27** Mr Tom Parker is a graduate of the University of Edinburgh and was taught by Professor Bisby, and Professor Torero. In addition, he has over the course of his 3-year career as a fire safety engineer at Arup had various technical reasons on his projects, and projects for other employees of Arup, to interact with personnel from Kingspan, Celotex, Siderise, BRE, Exova Warrington fire. All of these organisations are referred to herein.
- 1.4.28** During his time as a professional engineer he has worked on projects or reviewed projects where the building envelope contained combustible materials.

1.4.29 Mrs Danielle Antonellis is a graduate of Worcester Polytechnic Institute. She was professionally employed by Tyco Fire Protection Products (now Johnson Controls) and since May 2014 by Arup as a fire safety engineer. Danielle was previously based at Arup's Boston (USA) office and Arup's Hong Kong SAR office. She has been based at Arup's London office since February 2018. She has not currently worked with any of the parties identified in the Public Inquiry.

1.4.30 Mr Alfie Chapman graduated from the University of Edinburgh in 2016, he was taught by, and the second reader of his MEng thesis was Professor Luke Bisby. He joined Arup in Edinburgh in September 2016 and has since returned to the University of Edinburgh to give recruitment talks. He has not worked with any other parties identified in the Public Inquiry.

1.4.31 In my investigation of the facts and in expressing my opinion herein, I do not consider these interactions to have caused any actual or potential conflict of interest.

1.5 Disclaimer

1.5.1 I understand that this report will be made available to the Core Participants in these Public Inquiry proceedings, the Core Participants' legal advisers, the Judge and his assessors, and this report has been prepared to that end.

1.5.2 In all other respects, this report is confidential and may not be used, reproduced or circulated for any other purpose (whether in whole or in part) without my prior written consent.

1.5.3 Neither I nor Arup accepts any responsibility to third parties for the unauthorised use of this report.