The Fire Risks of High-Rise and Purpose-Built Blocks of Flats in England: What Can (and Could) Official Fire Incident Data Tell Us?

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About us

Phil Murphy is an independent consultant advising landlords and responsible persons on fire safety management of tall residential buildings. He was lead technical fire safety author of the Housing Health and Safety Rating System (HHSRS) Addendum for High-Rise Residential Buildings. A former firefighter and Fire Prevention Officer (1997-2009) with GMFRS, Phil also has ten years private sector experience of managing fire safety across national portfolios of large and complex buildings. He also spent over a decade as a resident of high-rise blocks.

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Stuart Hodkinson is Associate Professor of Critical Urban Geography at the University of Leeds specialising in residents' experiences of housing regeneration. Stuart has worked with resident groups for past 15 years. His most recent book is called *Safe as Houses: Private Greed, Political Negligence and Housing Policy after Grenfell* (MUP, 2019).

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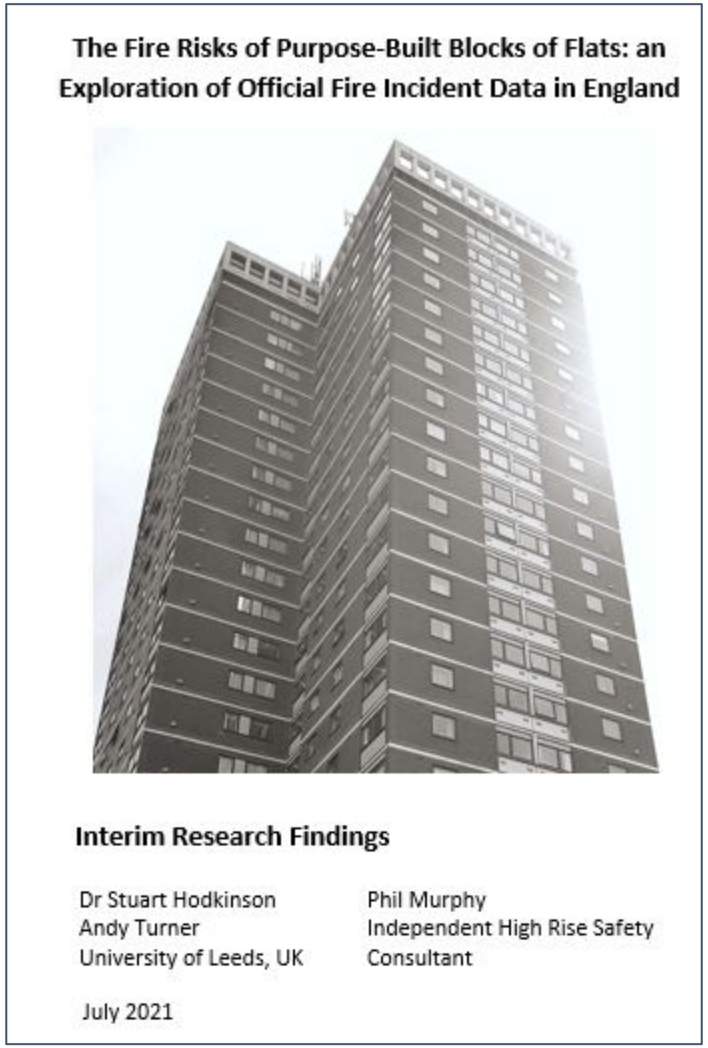
Outline

- Post-Grenfell high-rise safety debate
- Remembering the enhanced fire safety risks of high-rise
- Our research: aims, data and analysis
- Findings
- Conclusions


The Fire Risks of Purpose-Built Blocks of Flats: an Exploration of Official Fire Incident Data in England

Interim Research Findings

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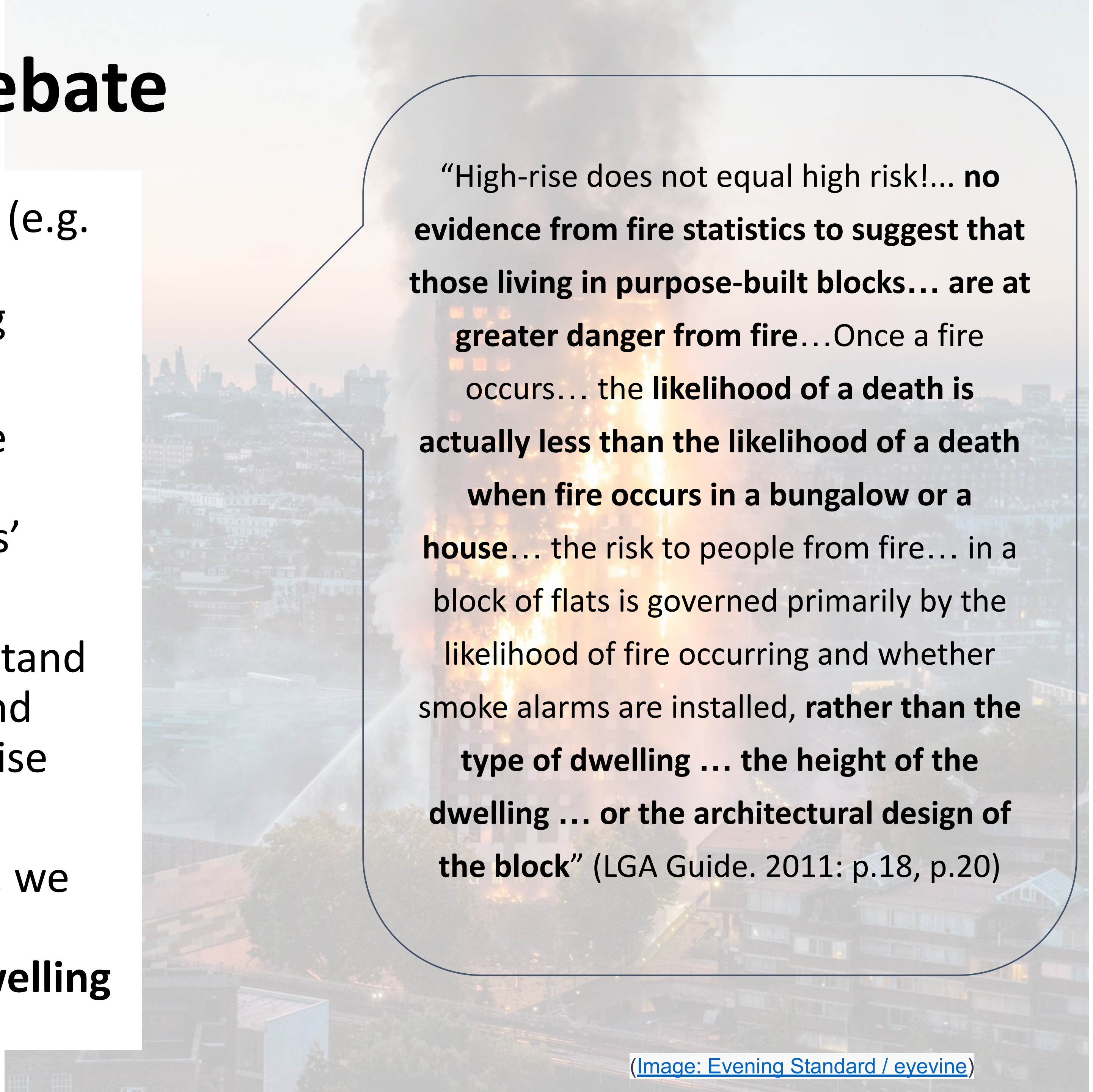
If you would like a copy of report you can download it for free here: https://t.co/tpQB8gsY5V

High-rise fire safety debate

- Pre-Grenfell regulatory environment (e.g. stay put): ‘article of faith’ in compartmentation design and falling fatalities in official statistics
- Grenfell Public Inquiry: ‘show me the bodies’ perspective underplays ‘low probability, high consequence events’ (Kernick, 2021)
- Our research aimed to better understand what official fire incident data can and could tell us about fire risks in high-rise and other blocks
- Using unpublished fire incident data, we found **increased risks of fatality or casualty from type and height of dwelling**



“High-rise does not equal high risk!... **no evidence from fire statistics to suggest that those living in purpose-built blocks… are at greater danger from fire**…Once a fire occurs… the **likelihood of a death is actually less than the likelihood of a death when fire occurs in a bungalow or a house**… the risk to people from fire… in a block of flats is governed primarily by the likelihood of fire occurring and whether smoke alarms are installed, **rather than the type of dwelling … the height of the dwelling … or the architectural design of the block**” (LGA Guide. 2011: p.18, p.20)

(Image: Evening Standard / eyevine)

Remembering the enhanced fire safety risks of high-rise living

Vertical communities with limited means of escape

- Much greater probability of fires starting and then going on to affect a potentially much larger population than a simple house fire
- England, high-rise 30 metres+ hold average 81 flats / 154 people
- Grenfell Tower had 120 flats / 340 residents

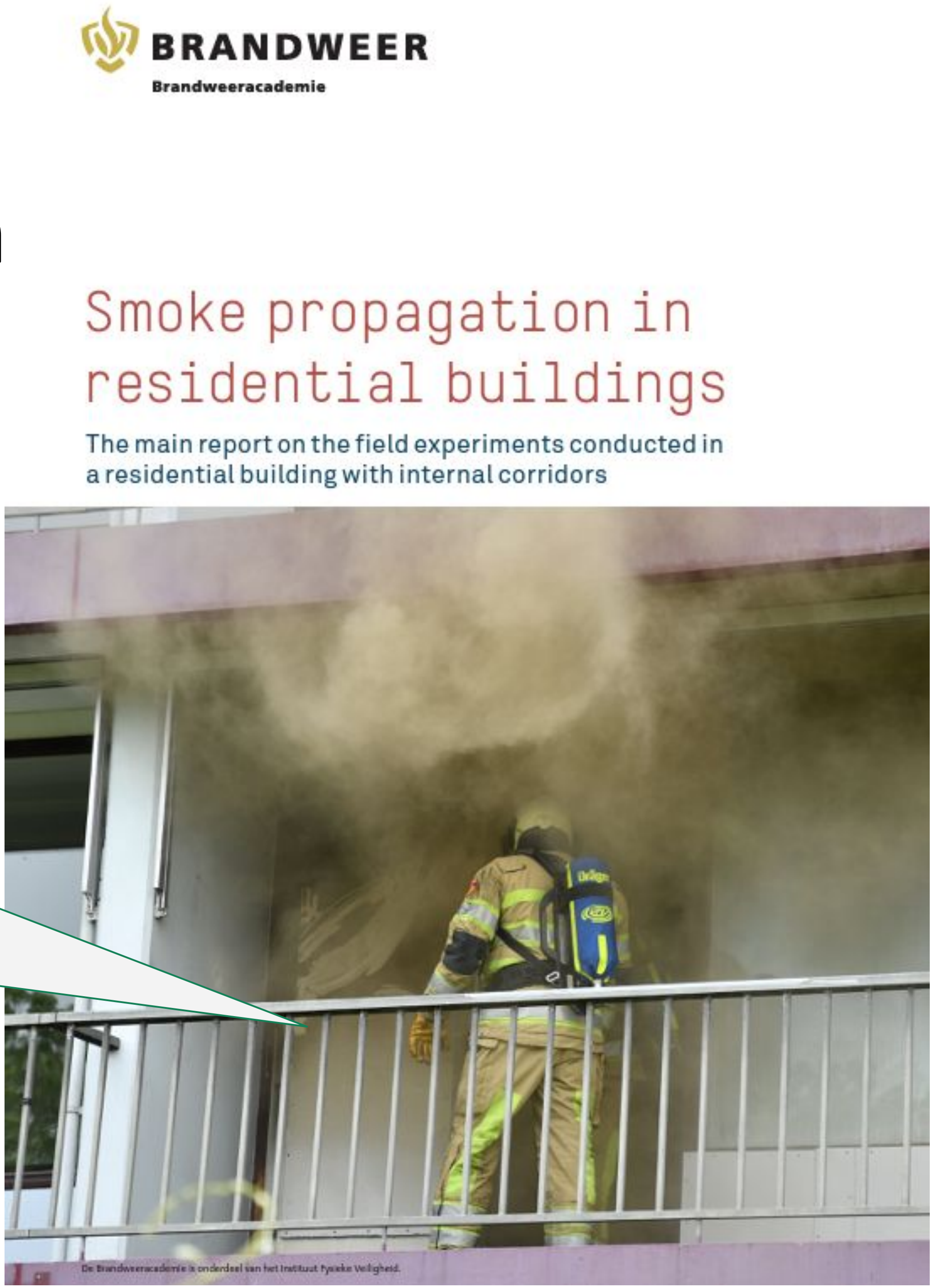
Typical house >6 exit routes near to fresh air

Flat dwellers usually have one means of escape: long distance subject to hazards reducing survivability

Dangers of smoke propagation and defective compartmentation

Life Safety Institute and the Fire Brigade Academy of the Netherlands 2019 experiment in an empty residential care complex: set fire to a settee in a studio flat on the first floor, twenty times over two weeks.

“In all the tests, smoke propagated outside the fire room through several horizontal and vertical routes and sub-routes. This involved both horizontal and vertical smoke propagation to different rooms in the residential building. This means that if only part of a sofa is burning in one room, high-risk situations will occur in several locations in the residential building.” (Fire Service Academy 2020: p.3)



PDF download, English version of main research report, [click here.]

Vertical Response Times

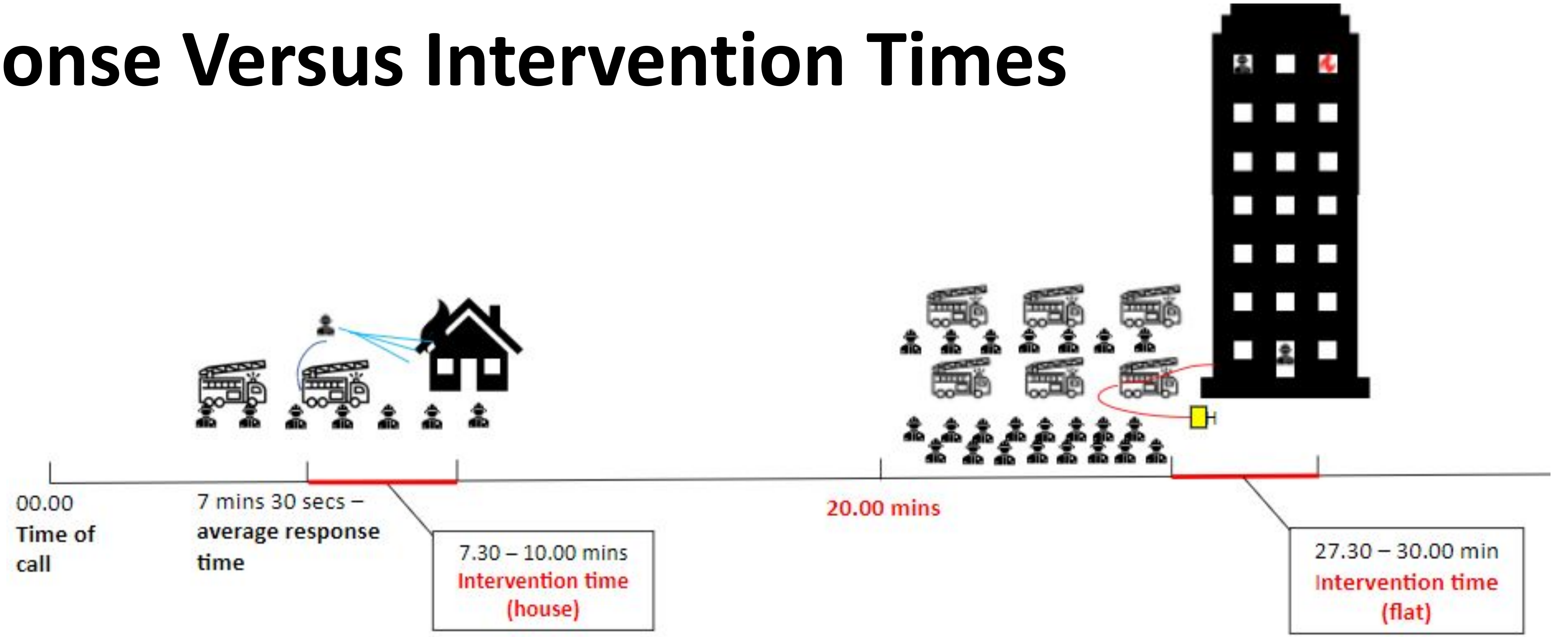
Following 2005 deadly tower block fire in Stevenage, Hertfordshire FRS tested procedures for high-rise fires

They found it takes 20 minutes from arrival at the incident to establish a bridgehead with the resources required to deal safely with a fire on the upper floors

(Steve Seaber, Safer High-rise Living - The Callow Mount Sprinkler Retrofit Project)

Infographic Credit: Brent Brooks, OIC Toronto High Rise Response Unit

Response Versus Intervention Times



- Response to intervention in high-rise fires between 27 and 30 minutes from 999 call
- Assumes no delays to the start of firefighting (see later)
- Shrinking redundancy: it used to take 15 minutes for a fire to engulf an average living room - now it takes <5 minutes due to the quantity of plastics in our homes

Every Second Counts

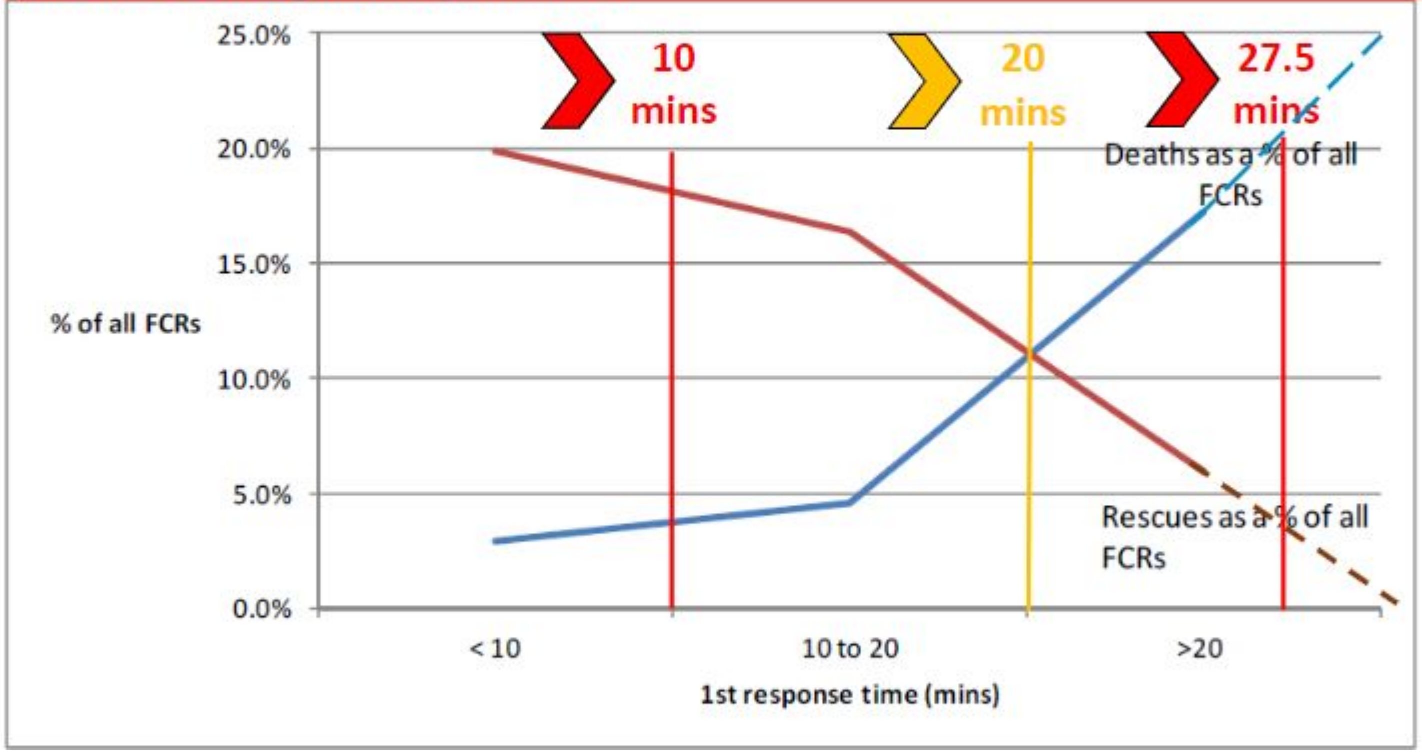
- National average response time is 7 mins 45 seconds (Home Office 2021)
- Government research found:
  - faster response times, greater probability of rescue and survival
  - longer response times correlate to a higher probability of fatality
  - 16 minutes: sharp deterioration in survival chances
  - 20 minutes: likelihood of death becomes higher than survival

Department for Communities and Local Government

2012 updates to the Fire Service Emergency Cover toolkit

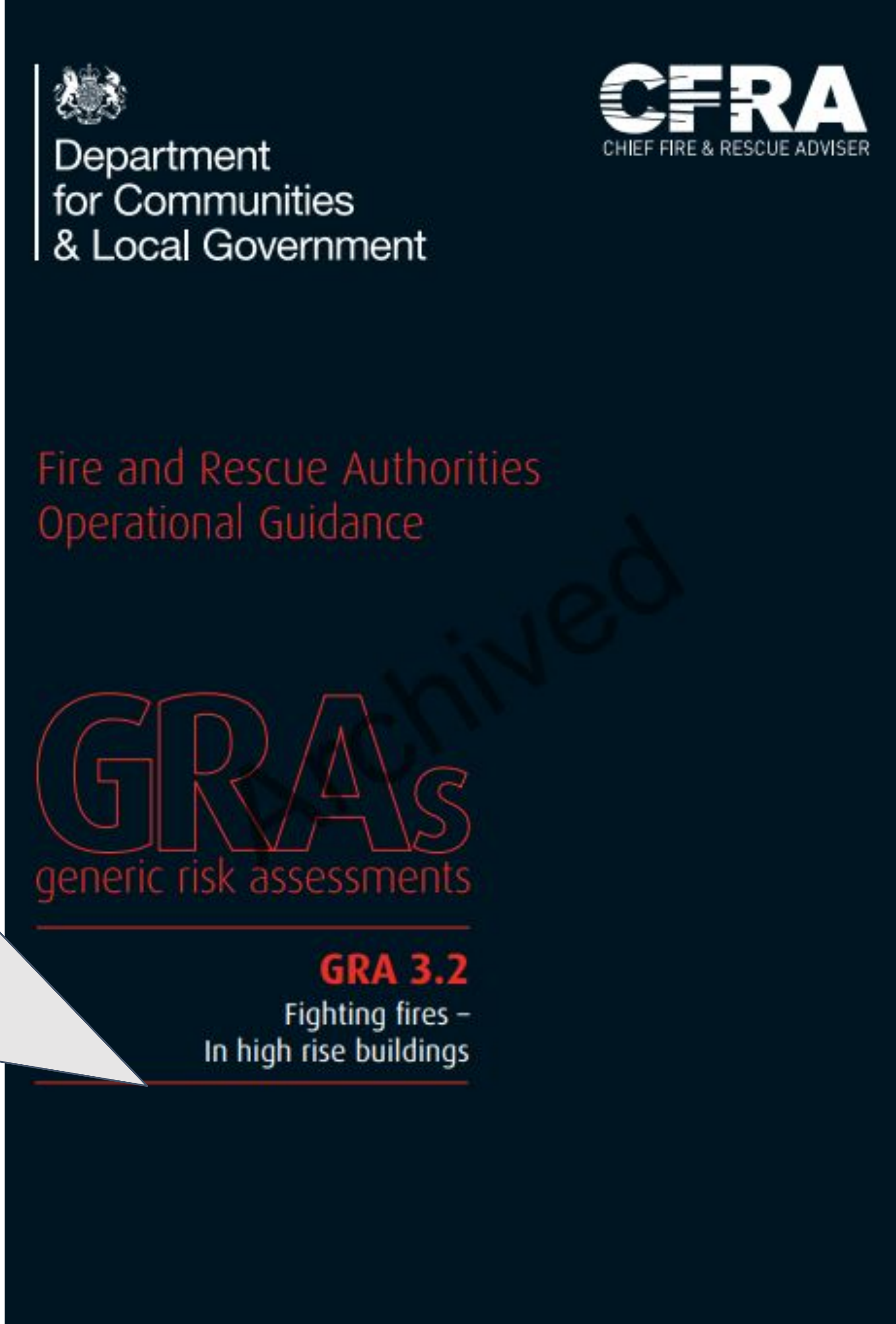
Special Service and fire fatality rate response time relationships

Figure 15: Per cent of Fatalities, Casualties (all grades) and Rescues that die versus per cent that are rescued against response times



Dangers of high-rise firefighting

“Fire and smoke spread can develop internally by breaching compartments, travelling along shafts and ducting and externally when fire breaks out of windows and through failed wall panels. This can lead to rapid spread to other compartments and floors (above or below), due to the effects of thermals, movement of hot gases and wind speed/pressure. Air currents may lead to smoke within the building being drawn upwards or downwards… **Fires may be encountered on more than one floor at a time...** Burning material falling from upper floors or propelled by the wind can also spread fires and start secondary fires by igniting combustible materials through open windows, on balconies and around the base of the building... Undivided stairways in high rise buildings have the potential to act as chimneys allowing the products of combustion to rise, which increases the risk of fire and smoke spread to other floors… Fires in refuse or refuse containers can create extensive smoke spread through chutes, other shafts and voids…”



Generic Risk Assessment (GRA) 3.2 Fighting Fires – in High Rise Buildings. London: Her Majesty’s Stationery Office, [URL]

Our research

What does official data tell us about risk in relation to height and type of dwelling, the effectiveness of compartmentation, the means of escape, and firefighting infrastructure in an individual building?

- Home Office publishes detailed information on every fire incident attended by FRS since April 2009 via online Incident Reporting System (IRS)
- IRS contains over 160 questions that firefighters answer as soon as possible after the incident
- We accessed annual **incident-level data** from 2010/11 to 2019/20 containing 65 data fields (24 additional fields to publicly available data)
- Our analysis focused on **302,130 dwelling fires** (excludes hostels/hotels/B&Bs, nursing/care homes, and student halls) over a **10 year period** (19.6 million data points)

Data fields

Standard published fields		Additional fields provided by Home Office	
Fire and Rescue Service	Source of ignition	Multi seated flag	Building origin floor size
Financial Year And Month	Fire start location	How discovered description	Building origin room size
Weekday/Weekend	Other property affected on arrival	Compartmentation	Fire size on arrival description
Morning/Afternoon/Evening/Night	Item ignited	Means of escape	Building evacuation delay description
Dwelling / Property Type	Item causing spread	Building occupied at time of incident	Building evacuation time description
Building Special Construction	Building special construction	Action taken by FRS	Fire size on arrival description
Occupancy type	Vehicles	Action taken by non-FRS	
Occupied normal	Personnel	Were active safety systems present	
Alarm system	Response time	Starting delay description	
No alarm	Time at scene	Cause substances dangerous	
Alarm system type	Fatality or casualty	Cause where explosion involved	
Alarm reason for poor outcome	Rescues	Cause substances explosion	
Ignition to discovery	Evacuations	Cause explosion stage	
Discovery to call	Fire damage extent	Cause explosion containers	
Late call	Total damage extent	Building floors above ground	
Accidental or deliberate	Fire size on arrival	Building floors below ground	
Cause of fire	Spread of fire	Building floor origin (of fire)	
Ignition power	Other property affected at close		
	Rapid fire growth		

Analysis, Dwelling Fires and Data Issues

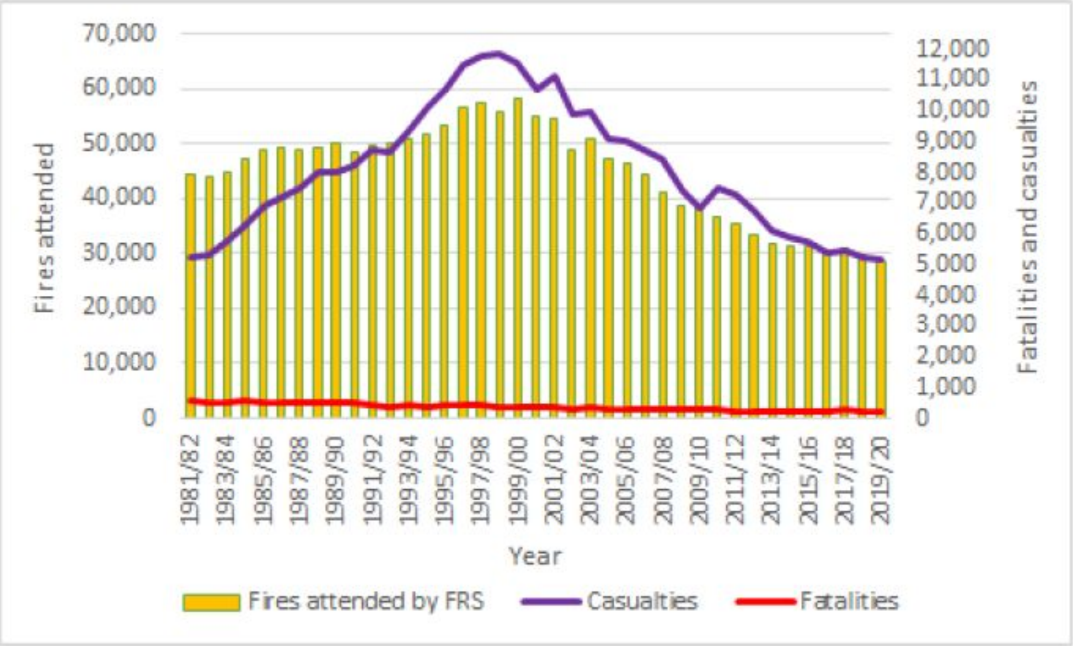
- Quantitative analysis: single variable summaries for each field and selected count summaries cross-tabulated with different variables to explore relationships between them
- Explored associations between different dwelling/property types and frequency of fires, rates of fatality or casualty, height of building, floor of fire origin, fire spread and delays to firefighting
- IRS data inconsistencies in recording of building height for 8% of purpose-built incidents (6455 fires): height category (low-rise, medium-rise, high-rise) contradicted by data in ‘floors above ground’ field or ‘floor of fire origin’ field
- We assumed FRS more likely to click wrong building-type than input wrong floor height data so we reclassified those fires, which led to some interesting results
- **Our methodology and assumptions are explained in detail in our report**

Dwelling Type
Houses
Bungalows
Purpose-Built Flats 1-3 floors (low-rise)
Purpose-Built Flats 4-9 floors (mid-rise)
Purpose-Built Flats 10+ floors (high-rise)
Converted Flats / Maisonettes
Houses of Multiple Occupation (HMOs)
Other Dwellings

Findings

1. Official narrative of falling fires masks increases for certain heights of purpose-built flats

Primary Dwelling fires attended in England, and related fatalities and casualties, 1980/81 to 2019/20



[Home Office 2017]

- In contrast to published Home Office statistics, when we reclassified fires based floor date in the IRS, we found a much greater degree of variation in purpose-built fires by building floor height between 2010/11 and 2019/20
- While fires to low-rise blocks have fallen by over 29%, **medium-rise fires actually increased by 12.5% over the decade** (probably due to increased stock of that type) and high-rise fires fell more slowly than previously thought (6.5%)
- Individual floor height analysis also shows a variable picture (next slide)

Purpose-built fires by building floor height that increased over decade

Building height (floors)	2010/11	2019/20	Change in annual fires between start and end year (%)
4	898	950	+5.8
5	294	398	+35.4
6	187	234	+25.1
7	91	110	+20.9
9	99	101	+2.0
11	68	94	+38.2
13	70	75	+7.1
18	26	29	+11.5
20-43	46	59	+28.3

Fires attended by FRS 2010/11 to 2019/20 by height of purpose-built dwelling - change over time

2. Once a fire breaks out, high-rise residents are twice as likely to die than in house fires

- bungalow fires are outliers due to the predominance of elderly and disabled residents who are far more vulnerable in the event of fire
- more meaningful comparison is with houses against which purpose-built flat fires have higher rates of casualty and casualties requiring hospitalisation
- high-rise flats have a significantly higher average annual rate of fatalities and casualties, most likely to result in hospitalisations

Comparing decade average rates of fires resulting in fatalities and casualties

	Fatalities	Non-fatal Casualties	Non-fatal casualties Requiring Hospitalisation	Severe Non-fatal Casualties Requiring Hospitalisation
	Per 1000 fires decade average (rounded)			
Bungalows	14	219	90	16
Houses	7	182	79	13
All Purpose-Built Flats	6	201	90	14
Purpose-Built Flats Low-Rise (1-3 Floors)	6	209	93	15
Purpose-Built Flats Medium-Rise (4-9 Floors)	4	172	83	9
Purpose-Built Flats High-Rise (10+ Floors)	14	217	90	20

Source: Home Office Table 205

3. Flat dwellers far more likely to experience a fire in their building and become a victim

Dwelling fires attended by FRS 2010-11 to 2019-20 by dwelling type and as proportion of English housing stock and population

Dwelling Type	As % of English Housing Stock using decade mean	As % of England's Dwelling Fires using decade mean	Fires attended per 10,000 dwellings of type	Fires attended per 10,000 people
All dwellings	**100**	**100**	**12.6**	**5.4**
Bungalow	8.9	5.8	8.3	5.5
Houses (including HMOs)	70.8	59.4	10.6	4.1
Purpose-built flats	16.4	27.3	21.0	11.8
Purpose-Built Flats Low-Rise (up to 5 floors)	14.4	22.8	19.9	10.9
Purpose-Built Flats High-Rise (6 floors +)	1.9	4.5	29.0	19.1

When fires are normalised by populations living in each dwelling type (using English Housing Survey):

- high-rise (6 floors +) residents nearly 2 x as likely to experience a fire in their building than block below six floors, and nearly 5 x those in a house
- flat dwellers have far higher probability of dying (more than double) or being injured (nearly fourfold) than residents of houses

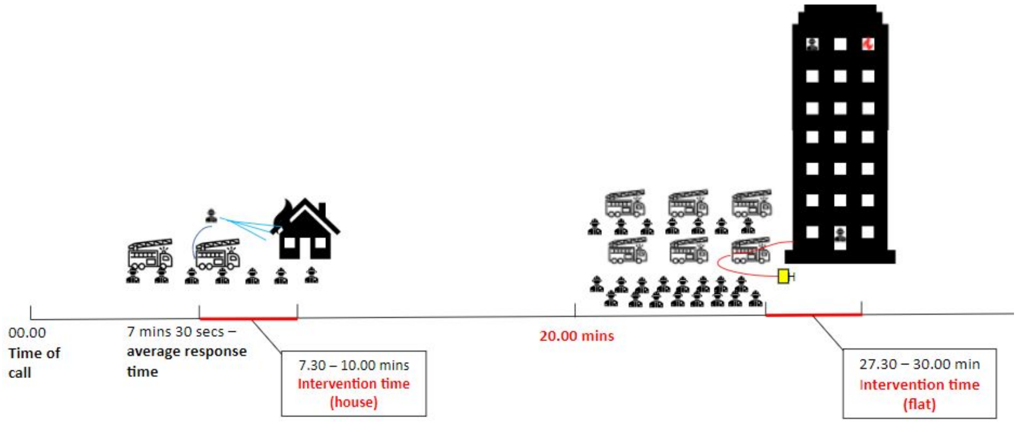
4. Deliberate fires: role of building typology

Purpose-built blocks have additional sites of vulnerability to a fire starting and arson from multiple shared spaces reflected in incident data

- 37.7% high-rise fires (10 floors +) start **outside of a dwelling** compared to 14.8% for houses
- 16.5% purpose-built fires are arson, compared to 9.9% for houses
- 41% of purpose-built flat fires started outside of a dwelling were deliberate compared to 26.4% for houses

Top: Heights West, Leeds; Bottom left: Trellick Tower
Bottom right: Luton Today (2018)

5. High-rise: frequent delays to start of firefighting



- delays to firefighting correlate with a far greater likelihood of fire resulting in a fatality or casualty to purpose-built blocks of flats and especially high-rise buildings, jumping from 15.3% to 21.5% where a delay occurs
- house fires see only slight increase in fatality or casualty from 13.7% to 14.2% when a delay happens

Dwelling / Property Type	Main reason given for delay to firefighting as % of building type fires with delays							
	Building type e.g. high rise	*Large site*	*Security doors / security*	*Assault on firefighter*	*Civi disturbance*	*Fire location not immediately evident*	*Sent to wrong location*	*Vehicle access*
Bungalow	0.7	0.2	37.0	0.9	0.7	21.6	16.3	22.7
House (including HMOs)	1.5	0.6	25.5	0.7	0.8	25.0	16.9	29.0
Purpose-Built Flats High Rise (10+ floors)	61.8	0.9	13.4	0.2	0.1	17.3	3.8	2.5

Dwelling / Property Type	% fires with delay to firefighting
Houses (including HMOs)	3.0
Purpose-Built Flats Low Rise (floors 1-3)	5.4
Purpose-Built Flats Medium Rise (floors 4-9)	9.4
Purpose-Built Flats High Rise (floors 10+)	20.1

6. Fire spread in purpose-built flats more common than assumed


Lakanal House
(Credit: Southwark News)

Options in the IRS for recording the extent of fire spread

Limited to item 1st ignited
Limited to room of origin
Limited to floor of origin (not whole building)
Limited to 2 floors (not whole building)
Affecting more than 2 floors (not whole building)
Whole building
Roof space only
Roof space and other floors(s)
External roof only
Whole Roof (including roof space)

- 1847 (2.3%) purpose-built fires involved significant and unusual fire spread either by FRS arrival or end of firefighting: **that is every two days on average over the decade**.
- fire spread incidents associated with marked increase in likelihood of death or injury: **29.6% fires involved a fatality or casualty, compared to overall rate of 15.5% for purpose-built**

7. Height increases risk to life in purpose-built fires

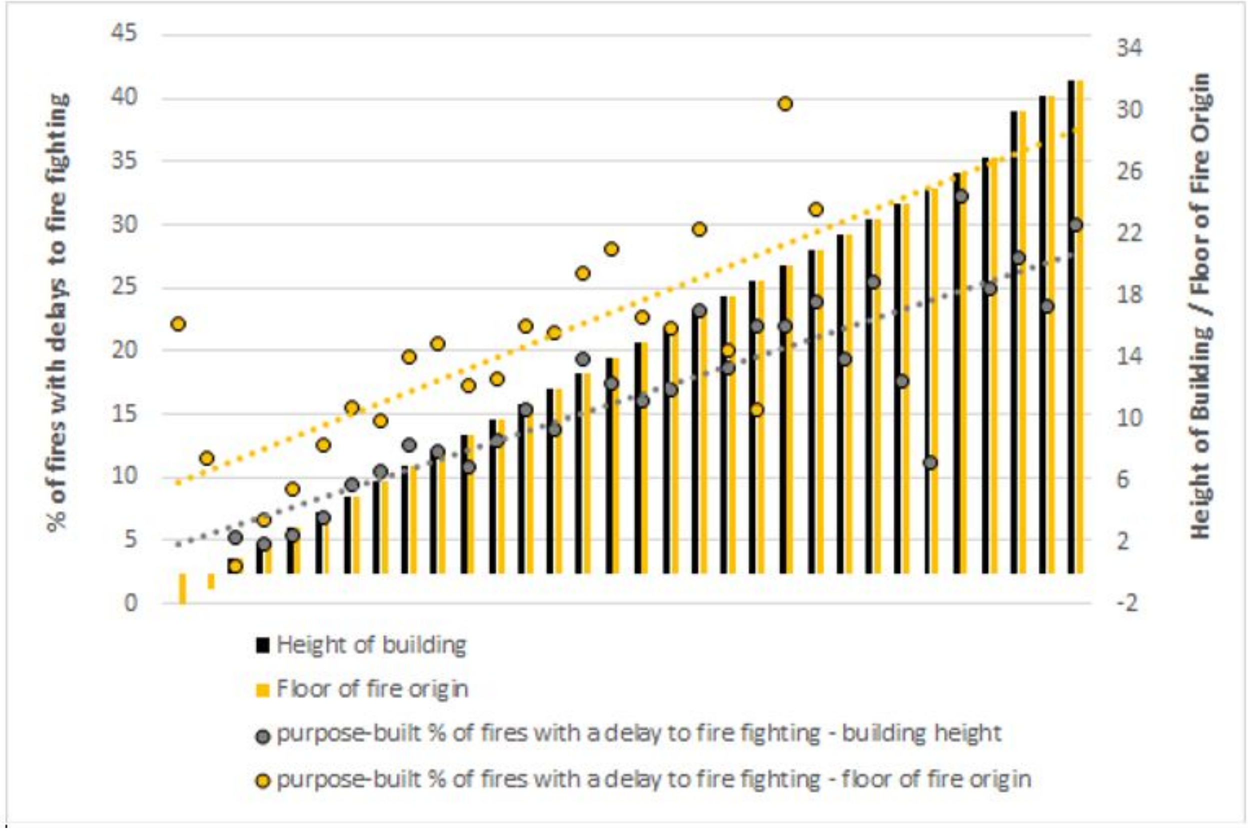
Clear positive association between increases in height of building or floor fire starts on and higher rates of fires resulting in a fatality or casualty

- fires from 6th floor upwards more likely to have a fatality or casualty than originating below
- 113 combinations of building height / floor of fire origin pose increased risk to life than house fires

Frequency of delays to firefighting increases the higher the floor origin of fire in purpose-built fires

- fires starting on 1st floor have a 2.9% rate of delays - similar to bungalows and houses - but this rises to 39.5% for fires starting on 20th floor
- 80% of fires between ground floor and 21st floor have a higher % of fatality or casualty when a delay to fire fighting occurs

Fires to purpose-built flats attended by FRS between 2010/11 and 2019/20 experiencing a delay to firefighting by height of building / floor of fire origin



Conclusions

- Overall trends and averages as presented in official fire statistics reports can hide increased fire risks for blocks of flats of certain heights and types that are clearly present in the data
- Risk increases with height. High-rise is definitely higher risk. An appropriate precautionary principle should be re-embedded in regulation and practice in association with high-rise residential buildings.
- Fire risk assessors need to be aware and learn from the investigations that followed previous fires and possess a more nuanced, in-depth knowledge of historic incidents and fire statistics
- The Incident Reporting System is not being used to its full potential and needs reform using feedback loop from stakeholders to continually improve, as was the case previously

Thank you for listening and we look forward to any questions today or by future correspondence

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References

British Automatic Fire Sprinkler Association (BAFSA) (2012), *Safer High-rise Living: The Callow Mount Sprinkler Retrofit Project* (URL)

Department for Communities and Local Government (DCLG) (2013), 2012 updates to the Fire Service Emergency Cover toolkit Special Service and fire fatality rate response time relationships, December, London: DCLG, [URL]

DCLG (2014), *Generic Risk Assessment (GRA) 3.2 Fighting Fires – in High Rise Buildings.* London: Her Majesty's Stationery Office [URL]

Fire Service Academy (2020). Smoke propagation in residential buildings. The main report on the field experiments conducted in a residential building with internal corridors. Arnhem: IFV

Grenfell Tower Inquiry (2019), Phase 1 Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017. October [URL

Home Office (2021) 'Response times to fires attended by fire and rescue services, England, April 2019 to March 2020', *Home Office Statistical Bulletin 01/21*, 14 January, [url].

Home Office (2021), Fire safety in purpose-built blocks of flats (formerly known as the LGA Guide 2011), https://www.gov.uk/government/publications/fire-safety-in-purpose-built-blocks-of-flats

Kernick, G. (2021), Catastrophe and Systemic Change: Learning from the Grenfell Tower fire and other Disasters. London Publishing Partnership