Safeguarding Escape Routes within High-Rise Buildings

Ultra Fog Ltd.

IWMC - 19th September 2018
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Overview

- Failures of compartmentation
- Subsequent justification against the use sprinkler systems
- Potential for water mist as a lower cost alternative

Retrofit sprinklers

Compartmentation

Existing buildings use compartmentation to prevent the spread of fire between dwellings.

- Dwelling should be able to contain a fire for at least 60 minutes
- Fire Brigade to bring the fire under control within this time.
- Neighbouring residents to stay put unless affected by heat or smoke.

Compartmentation failure

Lakanal House, 2009.

Shepherd's Court, 2016.

Grenfell Tower, 2017 - *public inquiry ongoing*.

Outcome of Lakanal House Inquest

1. Failure of compartmentation via inadequate fire stopping, an open window, and cross connection of ventilation ducts.
2. Fire spread rapidly - both vertically and horizontally.
3. 6 fatalities - all advised via phone to stay put to await rescue. Extensive smoke logging of the communal areas prevented rescue.
4. Coroner's Section 43 letter issued to the Council.

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Building Regs 2010, Section 8: Compartmentation, para 8.14

“Blocks of flats with a floor more than 30m above the ground level should be fitted with a sprinkler system [...]”

Under current UK legislation, there is no requirement for retroactive installation of sprinklers, unless a building undergoes significant structural changes or change of use

Lakanal House Section 43 letter

Source: https://www.lambeth.gov.uk/elections-and-council/lakanal-house-coroner-inquest

enable an assessor to consider whether compartmentation is sufficient or might have been breached.

Training of staff engaged in maintenance and refurbishment work on existing building

It is recommended that your authority consider the training needs of personnel who will be involved in procuring or supervising work to existing high rise residential buildings – whether maintenance, refurbishment or rebuilding of parts of buildings - to ensure that materials and products used in such work have appropriate fire protection qualities. Staff should, for example, be trained to understand the significance of the compartmentation principle and to appreciate when Building Control should be notified about work to be undertaken.

Access for emergency vehicles

It is recommended that your authority liaise with emergency services to consider access for emergency vehicles to high rise residential buildings, having particular regard to obstructions such as vehicle parking in locations which emergency services might need to use.

Retro fitting of sprinklers

Evidence adduced at the inquests indicated that retro fitting of sprinkler systems in high rise residential buildings might now be possible at lower cost than had previously been thought to be the case, and with modest disruption to residents.

It is recommended that your authority consider the question of retro fitting of sprinkler systems in high-rise residential buildings.

Response

Rule 43A of the Coroners Rules requires that you give a written response within 56 days beginning with the day on which the report is sent. If you are unable to respond within that time, you may apply to me for an extension. The response is to contain details of any action that has been taken or which it is proposed will be taken whether in response to this report or otherwise, or an explanation as to why no action has been taken.

As required by rule 43, I shall send a copy of this report to the Lord Chancellor.

At your request, I am copying this report to Ms Eleanor Kelly, Chief Executive.

Yours sincerely

Sprinkler feasibility study commissioned in response to the section 43 letter

Recommendations from the consultancy appointed by the Council:

Type of accommodation	**Installation of sprinkler systems into existing high-rise buildings**
Sheltered housing	Recommended
Temporary housing	Recommended
General needs housing	Not recommended. Instead, as a minimum, LD3 fire detection is strongly recommended.

Source: http://moderngov.southwark.gov.uk/documents/s42927/Report%20Lakanal%20inquiry%20-%20Sprinkler%20Feasibility%20Study.pdf

Justification?

Issues which were considered by the Council:

1. "Currently no legal requirement to install sprinklers in existing buildings [...]"
2. Council has "no right of access to leasehold properties" - retrofit within leasehold flats would require the owners' consent and, normally, their funding.[1]
3. "Effect on amenity" - pipe routing, accidental painting of sprinkler heads, aesthetics, coring/boring, disturbing the existing fire stopping, asbestos, etc.[1]
4. Cost

1. https://www.lambeth.gov.uk/sites/default/files/ec-london-borough-southwark-letter-response-to-rule-43-23May2013.pdf

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Building Regs 2010, Section 8: Compartmentation, para 8.14

"Sprinklers need only be provided within the individual flats. They are not required in the common areas such as stairs, corridors, or landings"

Indicative costs (2013)

Source: http://moderngov.southwark.gov.uk/documents/s42930/Appendix%203%20Feasibility%20report%20indicative%20costings.pdf

Costs calculated in 2013.
Excludes VAT, professional fees, inflation/deflation, and relocation costs.

Conventional Sprinkler Systems - lowered ceilings

£97M

Conventional Sprinkler Systems - pipework boxed-in

£27M

Total cost for 76 high rise, general needs housing blocks

Conventional Sprinkler Systems - lowered ceilings

£15.7k

Conventional Sprinkler Systems - pipework boxed-in

£3.7k

Average cost per flat

LD2 Fire Detectors

£0.7k

Average cost per flat

Costs benefit analysis
Shortfalls

The analysis was…

...based on the costings provided by one sprinkler company. *Realistic reflection of competitive tendering?*

...based on conventional sprinkler systems and personal protection sprinklers. Watermist not considered.

...based on application of building regs (*for new buildings*) to existing buildings.

2018 cost estimates

London Assembly
Planning Committee report:
“Never again: Sprinklers as the next step towards safer homes”

Considered sprinkler systems, but not water mist systems.

	Cost of retrofitting per flat	Retrofitting all buildings over 30 metres high in London[x]
BAFSA Callow Mount study[70]	£1150	£100.6 million
BAFSA	£1500 to £2500	£131.2m to £218.6m
Optivo[xi] and Fire Protection Association	£2000 to £2500	£174.9m to £218.6m
Essex County Fire and Rescue Service	£2260 to £3500	£197.6m to £306m
London Borough of Croydon[xii]	£4500 to £5500	£393.5m to £481m

Source: https://www.london.gov.uk/sites/default/files/final_afss_report.pdf
London Assembly Planning Committee 2018

London Assembly Planning Committee
Publication "*Never again: Sprinklers as the next step towards safer homes*" - March 2018
https://www.london.gov.uk/sites/default/files/final_afss_report.pdf

"*Other types of AFSS technologies are also available. These include water-misting and personal protection systems [...]. Water-misting can offer the ability to extinguish the fire, but typically require more individual sprinkler heads, higher water pressures and a more contained environment. Water mist systems are therefore generally more expensive than sprinklers.*"

An inaccurate generalisation of watermist, based on a specific product, having 5m² coverage per head.

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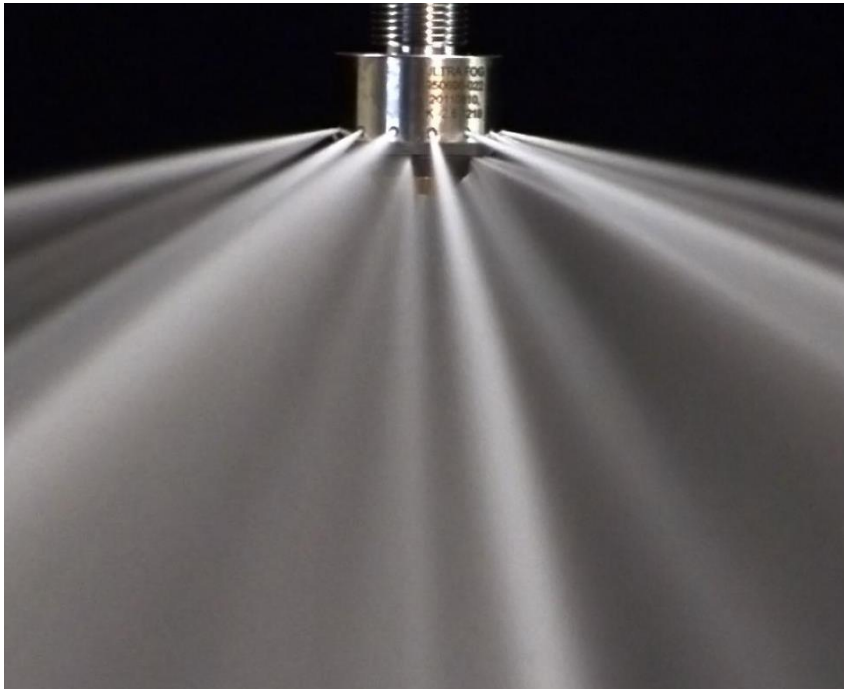
Water mist as a less expensive alternative to sprinklers?

Indirect fire suppression

Unlike sprinklers, water mist spray does not need to cover a fire to suppress the fire.

With a sufficient flux density, it is possible to suppress fires indirectly.

As cost represents a significant barrier to the retrofit installation of active fire suppression systems, is it feasible to protect a dwelling with a single watermist nozzle, to deliver economically viable, life-saving systems?



Example of indirect fire suppression: 48m² cabin fire test

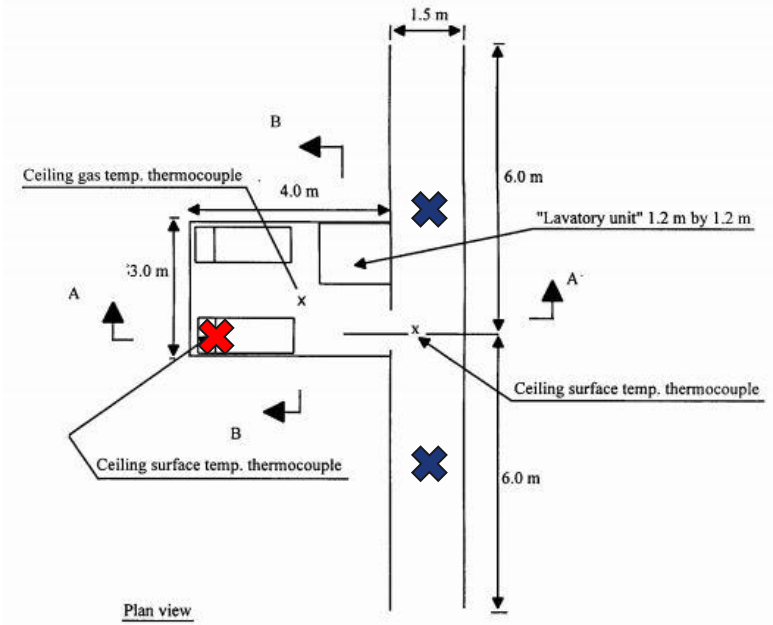
- Fire tested in accordance with IMO RESOLUTION MSC.265(84)
- Size of test room: 8m x 6m (48m²)
- Flow rate: 32.1 litres per minute at 100 bar
- Flux density: 0.27 litres per minute, per m^3
- Potential heat absorption approx.: 83 MJ

Example of indirect fire suppression: 48m² cabin fire test

Method - test scenario #4: “disabled nozzle test”.
“*The nozzle(s) in the cabin should be disabled. Fire arranged in one lower bunk bed and ignited with the igniter located at the front (towards door) centreline of the pillow…*”

Acceptance criteria:

- The fire is not allowed to propagate along the corridor beyond the nozzles closest to the door opening
- Max 30s average ceiling surface temp within the corridor shall not exceed 400°C



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Paradigm shift:

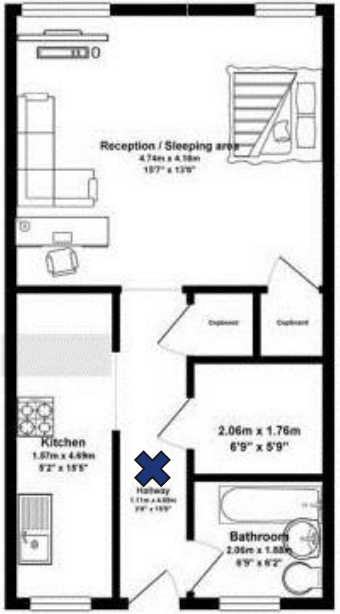
A single nozzle to actively protect the escape route within each dwelling, and to actively prevent the spread of smoke and flame from a dwelling into the communal escape route.

One nozzle per dwelling?

- Convention dictates that the sprinklers should be installed at the locations where a fire is most likely to start - to tackle the seat of the fire.
- This rationale is based on conventional sprinkler systems - whereby the water droplets quickly fall to the floor, thereby necessitating the use of large volumes of water to be delivered via nozzles located within reach of the fire.
- Water mist behaves differently. As demonstrated during fire tests to internationally recognised standards, water mist
    - Remains suspended in the air for longer;
    - Inhibits the transmission of radiant heat;
    - Suppresses fires even when the seat of the fire is obstructed or located in an adjacent room (via expansion and convection).

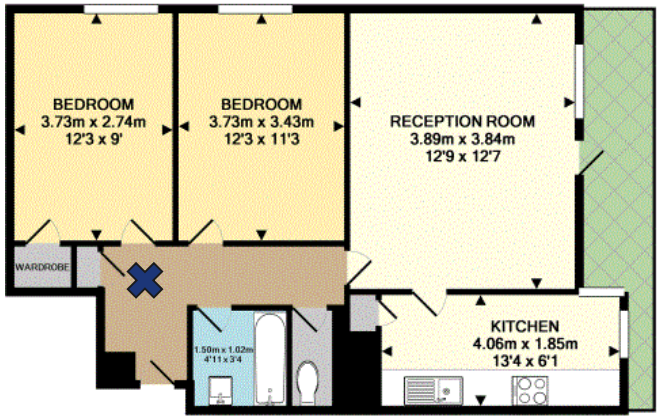
Examples of dwelling layouts

- Tissington Court, London
- Total floor area: 42m²
- Suggested location of single water mist nozzle ✖
- Location of water mist nozzle proposed to stop the spread of fire towards the front door (leading the block's communal stairwell)



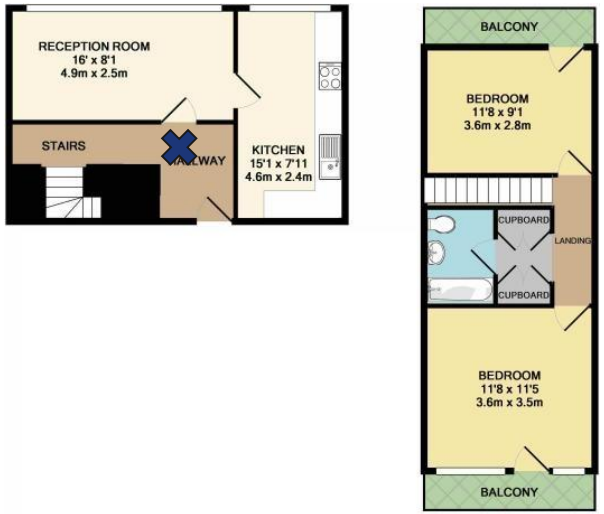
Examples of dwelling layouts

- Lupin Point, London
- Total floor area: 59m²
- Suggested location of single water mist nozzle ✖
- Location of water mist nozzle proposed to stop the spread of fire towards the front door (leading the block's communal stairwell), and to protect the escape route from both bedrooms.
- Minimal protection of kitchen and reception room - focus is on the protection of life rather than property.



Examples of dwelling layouts

- Castle Mead, London
- Interlocking “scissor section” flats, similar to Lakanal House
- Total floor area: 65m²
- Suggested location of single water mist nozzle ✖
- Location of water mist nozzle proposed to stop the spread of fire towards the front door (leading the block’s communal stairwell), and to prevent the spread of a fire from the kitchen or reception room to protect the escape route from the bedrooms.



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Local Government Association - Fire safety in purpose built flats
https://www.local.gov.uk/sites/default/files/documents/fire-safety-purpose-built-04b.pdf

"It is unlikely that retrofitting sprinklers or water mist systems would be reasonably practicable for existing blocks. Nevertheless, this does not preclude their use where there is clear justification and appropriate consideration of the practicalities of their installation and subsequent maintenance."

“Consideration of the practicalities”

- Access rights
- Funding
- Drilling/coring
- Fire stopping
- Asbestos
- Theft and vandalism
- Maintenance
- Water supply (pressure and flow)
- Space

Virtues of watermist in the context of high rise retrofit.

- High pressure
- Low water consumption
- Small diameter pipework
- Fewer nozzles
- Actively reinforces the building’s passive fire protection, by inhibiting the transmission if radiant heat.

“*Consideration of the practicalities*”
Sprinklers vs Water Mist

	Sprinklers	Water Mist	Comparative effect of water mist	Benefits of water mist
Droplet size (diameter)	1mm	0.05mm	-	More efficient use of water. Fewer nozzles. Lower water consumption. Smaller diameter pipework, less impact on the building during installation.
1 litre =	2 million droplets	15 million droplets	-	
Surface area per litre	6 m^2	120 m^2	Faster heat transfer, faster cooling of the fire.	
Terminal speed	1.4 m/s	0.3 m/s	Increased exposure time within the fire, smoke, and airflow.	

Further research

- Feasibility study
  - Indicative costs of retrofit single nozzle systems within high rise blocks
  - Fire testing
    - Define the test parameters:
      - Representative fire load
      - Representative layout
    - Define the quantifiable objectives, e.g., cooling rate, maximum allowable temperatures; etc.

Summary

- Cost remains a significant barrier to the retrofit installation of sprinkler systems in high rise residential buildings
- There is an assumption that water mist systems are generally more expensive than sprinkler systems
- Opportunity exists to safeguard life by simplifying the scope of protection via water mist.
- Evidence demonstrates that water mist is effective at inhibiting the transmission of radiant heat
- There is scope to apply water mist to actively enhance the compartmentation of high rise buildings, however, more research is required to establish the feasibility of this.

Thank you.

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