

Preliminary observations on a big tall residential complex fire

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1. Introduction

A big fire occurred [e.g. 1] in a tall residential complexes in the Hong Kong Special Administrative Region (HKSAR) afternoon of 26 November, 2025. There are 8 tall buildings under refurbishment since July 2024. Bamboo scaffolding and safety netting were erected around all building facades. A fire occurred in a flat first and spread vertically up to affect other flats at the same block. The fire then horizontally across with 7 of the 8 buildings involved. The fire was upgraded to alarm number 5 by the Fire Service Department (FSD) and deployed over 200 fire trucks and 177 ambulances. Over 2000 firefighters were sent to take emergency action. The burning duration was over about 44 hours.

As reported [e.g. 2,3], 159 people including a firefighter in the line of duty have died, 79 injured including 11 firefighters. 31 people are reported missing. This fire is considered the deadliest in Hong Kong in at least 63 years. Investigation started after controlling the fire.

Information available is limited at the moment. Only several insights gained from observations outside, and occasional news released by the government [4]. For example, preliminary investigation discovered highly flammable styrofoam cloaking lift windows on every floor. The foam was suspected to spread fire rapidly.

2. Observations from limited channels

As observed from television and news[1-4], key points are:

- Fire spread up fast vertically up a block by igniting combustibles fixed at façade, safety nets and bamboo scaffold.
- External wind blown strong.
- Fire also spread horizontally to other blocks in burning some surfaces with unknown reasons. External wind action was a possibility and fire-induced aerodynamics might also be likely.
- Flashover occurred at many flats as demonstrated by flames moving out of the broken windows.
- Evacuation appeared not fast enough with occupants stayed inside.
- Firefighters arrived fast with several water jets set up to deliver water at heights.
- Huge amount of smoke liberated and spread out as observed.

3. Possibilities and points to note

After reviewing those limited information, several interviews were held with the media [5-11]. The following is a summary:

A fire started at a lower flat with flame coming out, indicated flashover occurred. Combustibles at the façade was ignited with flame spread up very fast. Safety nets and even the bamboo scaffolds were ignited. Many flats above the ignited flat was involved with flame coming out too. Strong wind might drive fire to spread horizontally across and affecting other blocks. Eventually, 7 out of the 8 blocks were involved in the fire. Firefighters arrived quickly with several water jets set up at height. However, the fire grew big at a fast rate and firefighting actions took such a long time.

Questions to ask are:

- Flashover time for fire at the starting flat, due to accidental small fire or others?
- Combustibles involved in rapid upward fire spread, due to Styrofoam fixed at windows?
- Any other means on upward fire spread, additional openings at the façade for refurbishment?
- Consequences of igniting safety nets and bamboo scaffolds?
- Wind action on horizontal spread across the blocks?
- Heat removed by the water jets employed is adequate and higher than heat generated by the fires?

Therefore, the fire aspects of the investigation report should include the following:

- Flashover phenomena of the flat starting the fire.
- Fire spread along the block.
- Fire spread across to the other blocks.
- Wind action.
- Removal of heat by the water jets.

4. Investigation focusing points

Comparing with another number 4 alarm fire lasted for over 100 hours [12] in an old industrial building with mini-storage facilities [13], questions were raised by different parties at different places in many international conferences:

- Is the fire load density over 1135 MJm^{-2} [14] to have such a long fire?
- Any dangerous goods stored and ignited to facilitate flame spread?
- Limited ventilation fires of different flame colour, or burning flammable liquids?
- Air supply rates increased to burn more combustibles to give a big fire while operating [15-17] the positive pressure ventilation (PPV) to a 'ventilation-controlled' fire after flashover?
- High concentration of toxic gases, particularly carbon monoxide, emitted upon burning, due to inadequate air for burning and cooling by water?
- Inadequate number of water jets deployed in suppressing the fire with adequate amount of water?
- Any explosions inside the cabin stored, due to liquefied petroleum gas (LPG), explosive clean refrigerant or other flammable liquid?
- As raised by a group of overseas experienced fire officers:
When to send firefighters inside the fire site and under what physical parameters?

These questions should also be addressed in the recent big fire. Systematic research has to be carried out for addressing the above queries scientifically with support from full-scale burning tests, not just by building fire models with Computational Fluid Dynamics (CFD) as explain below. It is difficult to compile a report within a short time. Although there are some guessing appeared everywhere [e.g. 8].

Additional questions to above on this care are:

- Any additional fire protection for these buildings with high occupancy and sleeping risk under refurbishment?
- Why there is a facade fire, and due to putting in combustibles along façade?
- Any fire safety management during refurbishment?
- What are the difficulties in firefighting under such big fires and the schemes employed?
- Not using helicopters and water bomb as explained by the FSD are based on what data? Air can only be driven by helicopters, not generating!
- Any new scheme such as using unmanned aerial vehicles (UAV) and electric vertical take-off and landing (eVTOL) vehicles is available, and if not, any plan to develop?

5. Jumping up scenarios

As reported before [19], flame ejected from a compartment fire would spread up to high levels and ignite combustibles in there. The fire then jumped up the tall building one floor by one floor, giving a “jumping fire scenario.” Real-scale experiments had been carried out on part of a single skin façade with double glazing of height 7.5 m.

Flashover in the chamber was onsetted by setting up a gasoline pool fire. Another pool of same size and amount of gasoline was put in a chamber in the upper level above the first chamber. Upon igniting the pool fire at the lower chamber, flame spread out from the opening to act at the glazing system. Glass pane at the upper level was broken, igniting the gasoline pool in the upper chamber and onsetting another flashover fire. Flame then spread out from that upper chamber.

The process repeated when large amount of combustibles stored at the upper levels. This identified scenario of having fire sources jumping up in sequence along the façade is confirmed and should be considered in fire investigation.

6. Concerns in using CFD only

Many big construction projects in the Asia-Oceania region have difficulties to comply with the prescriptive fire safety codes. Performance-based design were applied with fire models. CFD [20] is widely used for hazard assessment in different areas for over 30 years. However, there are very little progress in developing research CFD software in the past 20 years.

Key points to note in simulating building fires by CFD were discussed [20]:

- Key fire phenomena are turbulence models, combustion process with intermediate chemistry and thermal radiation.
- Mathematical aspects to concern are the discretization of partial differential equations, algorithms for solving the velocity-pressure linked equations and treatment of the free boundary conditions.
- Selecting relaxation factors, convergence criteria, avoiding false diffusion, and dealing with sudden changes in flow parameters across the heat source.

There were very few verification and validation works, leading to numerous debates and queries on the technique. As most efforts were spent on applying CFD for building applications in those big projects rather than developing CFD.

Consequently, applications were limited to smoke management systems. Even so, CFD predictions are required to justify at the testing and commissioning stage. Hot smoke tests in the site are required to evaluate the performance of smoke exhaust systems. Therefore, fire investigation reports based on CFD only must be justified with some full-scale burning flats, or even real scale burning flats.

7. Importance of fire safety management

Basically, fire safety requirements are adequate and listed clearly for tall buildings in Hong Kong. Passive construction includes fire resisting constructions; means of escape; and means of access. Requirements of active systems known as Fire Service Installations (FSI) depends on building use. This includes alarm and detection systems; fire hydrant and hose reels; fire suppression systems; smoke management systems; and auxiliary systems such as essential supply system and emergency lightings [21].

The total fire safety concept of implementing appropriate software fire safety management to control hardware provisions in passive building construction and active fire protection system is necessary. A fire safety management scheme should be worked out.

However, site surveys carried out before [22] had identified. There are at least three problems:

- Refuse bins in staircases.
- Decoration of hose reel cabinets.
- Blocking of fire service inlets.

The importance of fire safety management should be considered to be a key component in facility management [23]. But now, combustibles are suspected to fix at the windows.

An assessment scheme [24], based on some identified risk parameters might be useful to determine fire risk in old buildings. Attributes in relation to passive building design, fire service installations, fire safety management, social issues and political issues should be considered. A score can be allocated from based on these attributes to give a “risk index” for determining appropriate fire safety management scheme.

8. Conclusion

Consequent to having such a big fire disaster, current fire safety provisions is urged to be reviewed by the general publics. Enhancement or improvement are requested for the existing fire safety provisions. However, it is difficult to revise the existing building codes without systematic research. New hardware requirements might not be viable and costing too much. Enhancing fire safety management is easier to implement. But more importantly, safety culture should be promoted.

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BFTP25-1q