



WITH YOU ALWAYS

RE-Konnect

Risk Engineering Bulletin

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In Focus:

High Rise Fires due to External Claddings

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How does the fire spread and propagate

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Preface

Over the last two decades, increasing demand for buildings to be energy efficient has resulted in the increasing use of thermal insulation materials in their exterior structures. These insulation products, known as external claddings, comprise of outer thin metal sheets on either side of an insulating material, usually polystyrene or polyurethane. These materials are combustible and have had the unintended consequence of increasing the fire risks in high rise buildings.

A number of recent fires around the world in which such external claddings are implicated is worrying. In this issue of RE-Konnect, we provide you with a brief overview on the mechanism of fire spread in external claddings, some recent catastrophic high-rise fires and loss prevention measures to minimize high-rise fires.

Did You Know?

- In 2014, a cigarette butt in a plastic container was enough to ignite a facade of polyethylene external cladding on an apartment building in Melbourne, Australia. Once a small section of the facade facing a balcony wall was lit, the fire spread quickly and travelled up the side of the building in just 11 minutes.
- Claddings used in the Greenfell Tower were cheaper and more combustible version of two options available to Harley Facades, a building firm executing the renovation project. Harley Facades opted for Reynobond PE as opposed to Reynobond FR (Fire Resistant), which was just £2 extra per square meter.
- Hundreds of Reynobond PE cladding panels that were banned in the US over fire safety fears were fitted to the exteriors of high-rise towers in London in the recent years.
- U.S. fire departments responded to an average of 14,500 structure fires per year in high-rise buildings from year 2009-2013. These fires caused an annual average of 40 civilian fire deaths, 520 civilian fire injuries and \$154 million in direct property damage.
- Five property groups account for almost 74% of high-rise fires which include Apartments (62%), Hotels (4%), Dormitories (4%), Offices (2%) and facilities that Care for Sick (2%). The remaining 26% of high-rise fires occurred in mixed-use commercial buildings such as restaurants, stores and parking garages.
- Fires that originated in kitchen or cooking areas have been identified as the root cause in 71% of the high-rise fires.

Mechanism of Fire Spread

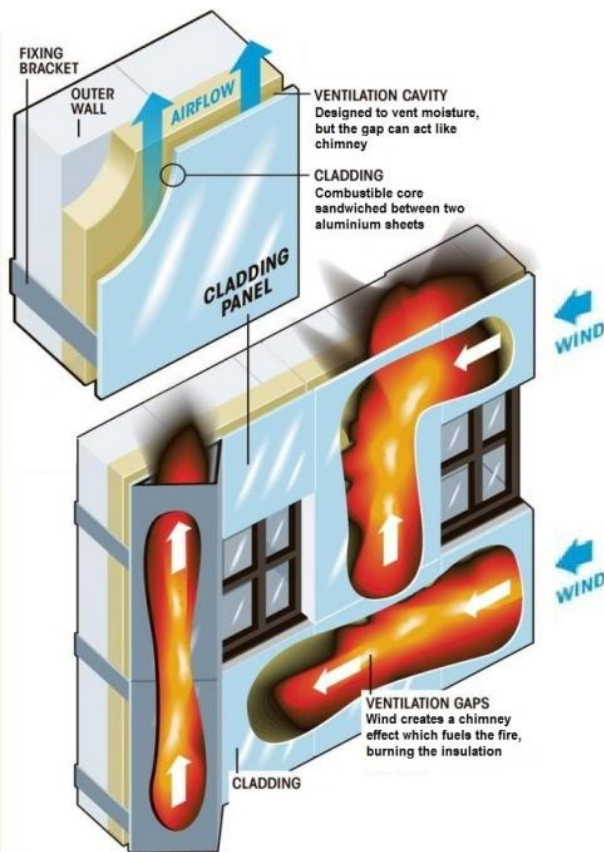
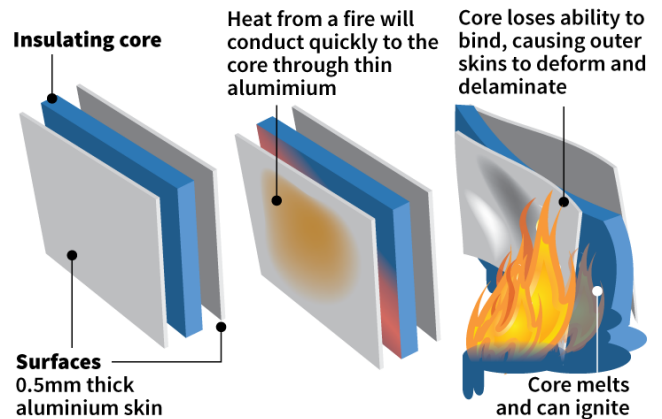
Initiation and breakout of fire

This type of fire event can be initiated from a fire occurring inside the building or by an external fire in close proximity to the building envelope, such as fires involving general waste or resulting from malicious fire setting. Following the initiation of a fire inside the building, if no intervention occurs, the fire may develop to flashover and break out from the room of origin through a window opening or doorway. Flames breaking out of a building from a post-flashover fire will typically extend 2 metres above the top of the opening prior to any involvement of the external facade and this is therefore independent of the material used to construct the outer face of the building envelope.

Interaction with the external envelope

It is at this stage of the fire scenario that the fire performance of the complete external cladding system, including any fire barriers, is critically important. Once flames begin to impinge upon the external facade of the building, from either an internal or an external source, there is the potential for the external cladding system to become involved and to contribute to the external fire spread up the building.

Aluminium composite panel



Surface propagation

The reaction to fire characteristics of the materials used within the external cladding system will influence the rate of fire spread up the building envelope by way of the surface of the external cladding system. If flames become confined or restricted by entering cavities within the external cladding system, they will become elongated as they seek oxygen and fuel to support the combustion process. This process can lead to flame extension of five to ten times that of the original flame lengths, regardless of the materials used to line the cavities.

Fire re-entry

Window openings or other unprotected areas within the flame envelope provide a potential route for fire spread back into the building. This creates the potential for fire to bypass any compartment floors that may be present, leading to a secondary fire on the floor above. If secondary fires are allowed to develop without intervention before flashover occurs

then flames may break out again, thus extending the flame envelope and threatening other openings further up the building.

Disasters

Within 51 days, the world witnessed 3 unfortunate events in cities separated by thousands of miles around the globe: London, Dubai and Honolulu. All three events can be described simply as preventable losses but because of the use of highly combustible exterior construction and/or lack of automatic fire sprinklers the fire spread to other floors of the high-rise structures.

Grenfell Tower, London

In June 2017, the 24 storied Grenfell Tower located in West London, UK experienced a tragic fire in which at least 80 people died. The 1974 concrete building was renovated in 2016 and retrofitted with aluminium composite panel claddings to improve energy efficiency and visual appearance. The cause of fire is reported to be a refrigerator on 4th floor. The fire spread and reached external openings. Once ignited, the highly combustible building claddings allowed the fire to spread rapidly up and along, and ultimately engulfing the entire building.



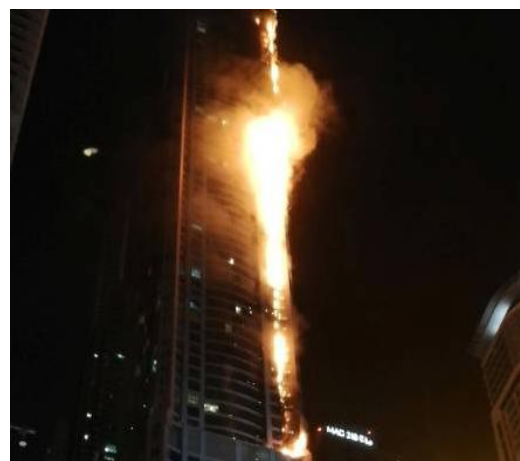
Marco Polo Apartments, Honolulu



In July 2017, the 36 storied Marco Polo Apartment located in Honolulu (Hawaii, USA) caught fire. Fire originated in 26th floor and spread to the exteriors of the building. The non combustible exterior construction limited the external fire propagation to upper floors. There was no significant fire spread along the building exteriors as experienced in the Grenfell Tower. In case of Greenfell the external fire spread within minutes, but in this case, due to the non-combustible concrete construction, the fire spread after 2 hours and was limited only to 2 floors of the 36 stories.

Torch Tower, Dubai

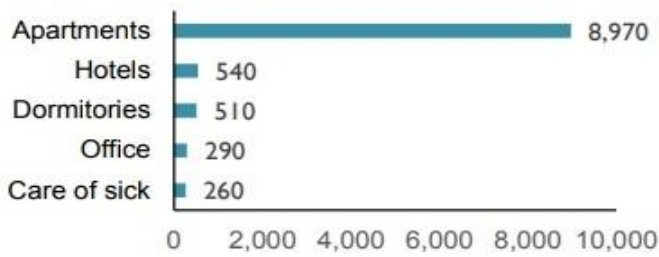
In August 2017, the 86 storied Torch Tower located in Dubai, UAE experienced its second fire in two and half years. The fire originated in 26th floor and spread to the top of building. It is reported that 38 units and exteriors of 64 floors of the tower were damaged. The cause of fire is reported to be the result of cigarette butts discarded into a potted plant. Torch Tower like most high rise buildings in Dubai was sprinkler protected and thus the fire was limited to exteriors of the building with minimal internal damages and most of the residents returned to their flats within days.



Loss Insights

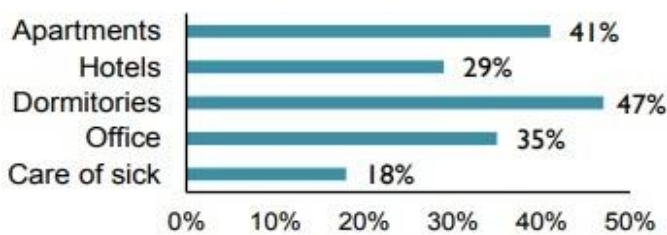
As modern construction practices drive buildings to new heights, no matter how efficient or resourceful the local fire service is, the different combinations of construction aspects always set the stage for fire service response and must be factored into building designs. Presented below are few loss statistics of the high-rise fires.

High-rise fires by occupancy 2009-2013 annual averages



The average number of high-rise fires in the properties per year during 2009-2013 is more than three out of five; 62% high-rise fires occurred in apartments or other multi-family housing. Hotels and dormitories or related properties each accounted for 4%, and office buildings and facilities that care for the sick each accounted for 2%.

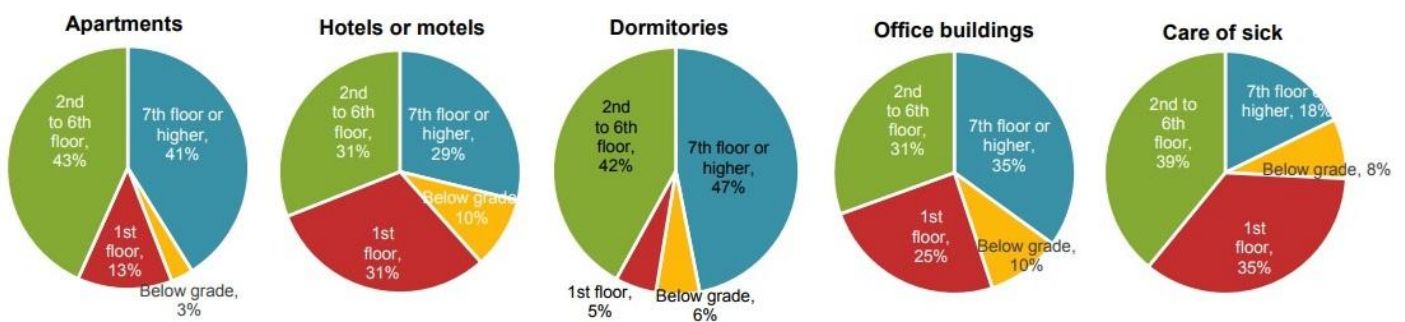
High-rise fires starting on the 7th floor or higher: 2009-2013



Most high-rise building fires begin on floors no higher than the 6th story. Statistics show that 47% of dormitory high-rise fires began on the 7th floor or higher, as did 41% of the apartment high-rise fires, 35% of the office building high-rise fires, 31% of the hotel high-rise fires and 19% of the high-rise fires in facilities that cares for the sick.

Ten percent of hotel and office building high-rise fires actually started below grade. The figure shown below presents a general breakdown of level of origin for the five different occupancies.

High-Rise Building Fires by Level of Fire Origin 2009-2013



Hotels, office buildings and facilities that care for the sick often have restaurants or cafeterias, small stores and other types of activities on the first floor. This may explain the higher percentages (25-35%) occurring on the first floor in these properties. Only 5% of the high-rise dormitory fires and 13% of the high-rise apartment fires began on the first floor.

Source: NFPA Research, 2016

Loss Control

Fire Protection

Although high-rise buildings may be of fire-resistive construction, the occupancy and interior finish may provide a significant combustible load. As a result, these buildings can be exposed to major fire and smoke damage requiring a large fire-fighting force. Fire-resistive construction and compartmentalization have not prevented exterior and interior fire spread in high-rise buildings. Consequently, they are not a substitute for automatic sprinkler protection when combustibles are present. *The use of automatic sprinklers is undoubtedly the most effective measure of fire control.* To the extent that sprinklers can be relied upon to control or extinguish a fire in any part of a building before substantial smoke is produced, they represent a smoke control system, as well as an extinguishing system.

Fire Service Operation

Fire in a high-rise building imposes more physical demands on a fire service than a similar fire in a low building. Access to the fire floor may be impossible during the early stages of the fire due to the inaccessibility of elevators and stairwells or due to evacuation of occupants. Once in the vicinity of the fire, fire-fighters are confronted with heat and smoke. Automatic sprinklers will protect against smoke and fire and therefore, will make fire extinguishing efforts more reliable. *For effective manual fire-fighting, fire safe access to each floor of a high-rise building is needed, especially in un-sprinklered buildings.*

Sealing Openings / Penetrations

Fire in wires and cables that are grouped together in one location such as junction boxes, manholes, cable trays, crawl spaces under control rooms, cable spreader rooms, above suspended ceilings, vertical chases, cable trenches, and similar places are responsible for many serious losses. Insulation failure is usually followed by arcing and overheating because of excessive electric current, which may ignite combustible insulation. The ensuing fire is often well advanced before it is discovered, and frequently, extinguishing agents cannot be applied promptly due to its inaccessibility. When the cables penetrate vertical and horizontal fire barriers, fire may spread to other areas through unprotected openings. *Consequently, these openings/ penetrations need to be protected with adequately designed and rated fire stops.*

Smoke Extraction

Modern high-rise buildings are being built with large open atria. These consist of a large, open core extending through the centre of the building from the lobby, possibly up to the roof. There are frequently multiple levels of commercial occupancies that surround the atrium on the lower floors; these may include restaurants, night clubs and a variety of shops. The remaining upper floors are either used for hotel rooms, offices or other occupancies, facing the open core of the building through open corridors. Fires in an atrium with combustible occupancy or in open areas facing the atrium, produce large volumes of heat and smoke that will rise through the atrium and possibly enter every floor. *A smoke removal system can be installed at or near the top of the atrium to remove heat and smoke and prevent the spread of these hot gases to exposed areas.*

Engage

Answer the following question and win Amazon coupons worth Rs 500 each. Send the answer to editor.bulletin@tataaig.com . Five winners for this quiz will be announced in the next issue.

Q1. Majority of the high-rise fires have originated from which of these areas of a building

- a) Living Rooms b) Bedrooms c) Kitchen or Cooking Areas

Q2. Which of the following is the major contributor of fire spread in high-rise fires?

- a) Fire origination in one of the floors
b) External Cladding with Combustible Core
c) Presence of Windows or Openings

Q3. Which of the following is most effective loss control measure to minimize high-rise fires?

- a) Sealing of Openings b) Automatic Sprinklers c) Smoke Extraction

Winners of the previous issue are as follows:

- **Naveen Kumar** – WMG Risk Advisory and Insurance Broking, Bangalore
- **Vishal Rana** – Munich RE, Mumbai
- **Vikas Singh** – Petronet LNG, Kochi
- **Aakash Manpuria** – Munich RE, Mumbai
- **Suketu Desai** – Global Insurance Brokers, Vadodara

Answers to previous questions: 1. Arabic 2. Any number of times 3. Increasing

For further information on this month's topic please contact:

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For feedback or comment related to the bulletin please contact: editor.bulletin@tataaig.com



High-rise apartment building fire in Shanghai, Nov 15, 2010

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<https://www.tataaig.com/PropertyEnergyLossPrevention>

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