

# Grenfell Tower Fire

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**Abstract:** West London, the Grenfell Tower in North Kensington was built in 1974. On Wednesday 14 June 2017 the fire was first reported at 12:54 a.m. Firefighters responded within six minutes. The blaze began on the fourth floor and spread to the top with a velocity and intensity that stunned 250 firefighters is on fight. 81 people died in this disaster. As a result of the fire, Grenfell Tower's displaced residents are now without a home. This disaster has happened because of the failure of newly renovated cladding system which catches fire. The cladding material should resist fire, and as per the norms of Fire Protection Association (FPA). This case study is helpful in studying the fire resistance concrete structures.

**Keywords:** Grenfell Tower, cladding material.

## 1. Introduction

### 1.1 History of the Grenfell Tower

West London, the Grenfell Tower in North Kensington was built in 1974. It is owned by the Rough Borough and Kensington and Chelsea and managed by Kensington and Chelsea Tenant Management Organization. The site plan is shown in

Fig.1. The tower is 24 storey's high and contains 120 flats. The typical floor plan and sectional elevation shown in Fig. 2, 3. There are approximately 400 to 600 people residing in the tower.

The tower is visible from the adjacent Avondale Conservation Area to the south and the Ladbrooke Conservation Area to the east due to its height. As the tower is a 40 year's old structure, they proposed changes in the existing tower to improve its appearance especially when viewed from the surrounding area. The changes in the structure include re-clad materials and windows which will represent a significant improvement to the environmental performance of the building and to its physical appearance. The work also included the installation of new double-glazed windows and a new communal heating system. A communal entrance is also provided as a new facility for returning occupants, Grenfell under 3s Nursery and Dale Youth Amateur Boxing Club. In this respect the tower is recently refurbished. Work finished by May 2016, ensuring a modernized tower with cladding and newly replaced windows. Additional homes were added using vacant space in the building in the Construction.

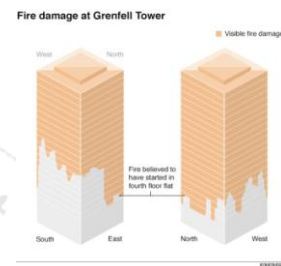
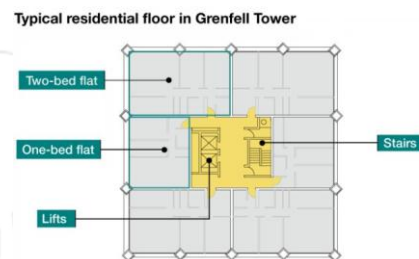
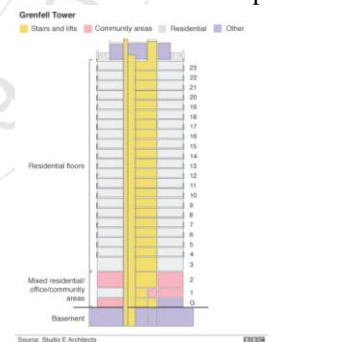


Figure 1: Location of Grenfell Tower (Apartment)



Source: Studio E Architects

Figure 2: Plan of a floor in Apartment



Source: Studio E Architects

Figure 3: Sectional elevation of structure

### 1.2 Description of Fire disaster

#### 1) Cause and origin of the fire

The explosion of an electrical appliance may cause the fire, from fourth floor but nothing has been confirmed in NEWS. And the fire appears to have spread via recently-installed cladding to the block. Actually Grenfell Tower's management company carried out an overhaul of the fire safety system, considering it is a model for many properties and in view of same approach will be applied for all major projects.

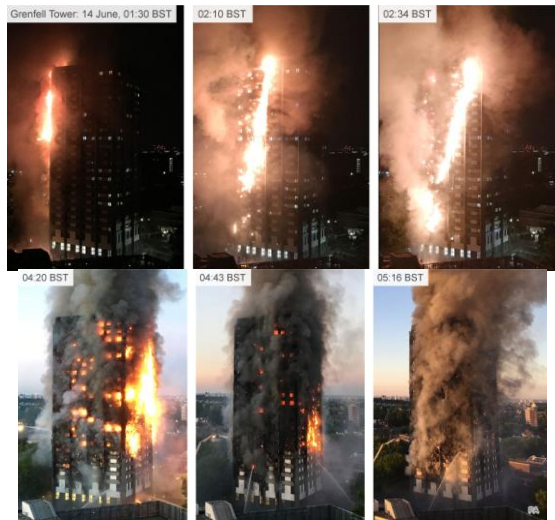


Figure 4: Fire growth scenario

## 2) Fire spread mechanisms and Consequences of fire

On 14 June 2017 Wednesday the fire was first reported at 12:54 a.m. Firefighters responded within six minutes. The blaze began on the fourth floor and spread to the top (Fig. 4) with a velocity and intensity that stunned 250 firefighters responded as in Fig.5. Pockets of fire are still blazing on next day morning. Then the fire broke out more than 24 hours after.



Figure 5: Fire fighting services

The building covered in cladding spread the fire quickly up the entire 24-storey building, according to architects and firefighters. Tenants felt smoke through cladding system realized the fire disaster while few are confused with alarm systems.

## 2. Grenfell Tower façade

### a) Insulation layer

The layer is Celotex has performed well in a number of fire tests, but it is combustible. Made from polyisocyanurate (PIR), it releases toxic fumes such as hydrogen cyanide when it burns.

### b) Air gap

The air gap ensures that condensation on the building evaporates and doesn't damage the outer walls. The gap may be helping the fire spread through a 'chimney effect' as shown in Fig.7.

### c) Cladding

Reynobond panels were used for cladding on Grenfell Tower. This is a layer of sandwich polyethylene between two aluminum sheets. The panels are flammable and official building regulations recommend that only panels with non-

combustible cores be used on buildings taller than 18 m. The cladding had a metal outer coating and an expanded foam interior.

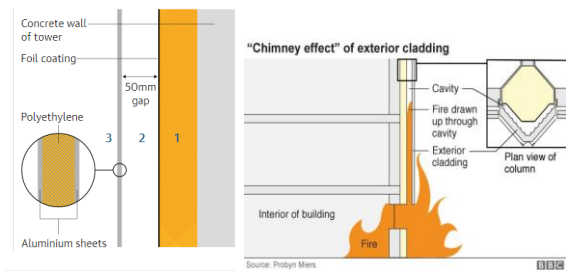


Figure 6: Cladding System

Chartered surveyor and fire expert Arnold Tarling, from Hindwoods, said that the renovating process could create a 25mm-30mm cavity between the cladding and the insulation. It produces a wind tunnel and also traps any burning material between the rain cladding and the building. All insulation used in the process is not sustained. So basically the tower got a cavity with a fire spreading behind it. Although the building met all the fire regulations, required and health and safety standards nevertheless the fire attacked the building. The material of the cladding could fire retardant, it should not catch fire easily, but the temperatures are raised to 900, to 1,000<sup>o</sup> c, and subsequent situations, somewhat material will burn. So the insulation material burnt and left thick black smoke.

On the day of fire, in the building 255 had survived and 14 were not at home, which would imply that 81 people had died out of 350. More than 50 people have been taken to five hospitals by London Ambulance Service. Families are screaming for help as flames ravaged in the building, whereas some reported to have leaped from windows in a desperate bid to escape. Some residents formed makeshift ropes with bed sheets as they tried to scramble to safety, while panicked parents tried to drop children out of windows into the arms of people below. It is hard to get out because the fire exit stairwell is on the side of the fire and so there is a lot of debris falling. Falling debris also caused nearby flats to be evacuated.

## 3. Detailed Discussion

Deficiency in structural system: A fire risk assessment for the tower conducted in November 2012, and cited by the Grenfell Action Group, said that fire extinguishers in the basement boiler room, the elevator monitor room and the ground floor electrical room were out dated. And Some Extinguishers located in the roof level areas had been 'condemned' as per the inspection report of 2009 or 2010 test dated. It was not clear if the extinguishers as mentioned above had not been updated.

The damage is more on the North-West and south faces of the Grenfell, whereas the East face is partially damaged as shown in fig.8. The damage is insignificant for the lower floors.

The window frames were deflected sagged due to exposure of high temperatures. And it seems cladding sheets become over burnt lot of visible cracks appeared on the façade.

If the cladding hadn't been there then the fire definitely wouldn't have spread that quickly. Usually, in tower fires, the concrete levels act as a sealed lock to contain the fire, but this has not happened here. The Firefighter added that people who had their windows open during the hot weather could also have been a factor: this allowed the fire to reach more fuel such as furniture.

The spandrel wall panel system used an ACM cassette rainscreen with an aluminum composite material covering polystyrene insulation. Polystyrene, according to the German flammability and combustibility rating system, is highly flammable or easily ignited. Subsequently, it is banned from being used in any exposed installations in building construction if the material is not flame-retardant.

#### Lessons to be learned

- 1) Through inspection of buildings are required regularly.
- 2) Inspections of buildings with respect of man-made disasters are required annually.
- 3) The material of the helmets of the fire fighters to be enhanced.
- 4) Use cladding material, which should be fire resistant and fire proof as per standards and specifications.
- 5) Residents are to be thoroughly trained for fire safety regulations, securities.

#### 4. Conclusions



- High rise structures designers ought to have thorough knowledge on fire safety measures, materials.
- Study and selection of materials of building in respect of fire is essential.
- The chosen cladding material should resist fire, and as per the norms of fire Protection Association (FPA), also as per the fire safety norms.
- Establishing specifications of materials in respect of fire are indispensable.
- It is better to place or stick fire safety instructions establishing policy at the building entrance and outside elevators on every floor so as to enable residents for safety and to warn for regular inspection.
- Structural frame consisting beams and columns of a building not only to design for gravity loads and wind loads but also for fire resistant.
- Assessing the structural adequacy of fire-damaged structural elements for restoration and renovation.

#### References

- [1] R.P. Pathak<sup>1</sup>, B.K. Munzni<sup>2</sup>, Pankaj Sharma<sup>3</sup>, N.V. Mahure<sup>4</sup>, Sameer Vyas<sup>5</sup>, MurariRatnam<sup>6</sup> Estimation of Fire Damage to Concrete Structure: A Case Study International Journal of Engineering Sciences, 2(4) April 2013, Pages: 130-136 ISSN 2306-647.
- [2] <https://www.nytimes.com/2017/07/10/world/europe/uk-grenfell-fire-death-toll.html>
- [3] <http://www.independent.co.uk/news/uk/home-news/london-fire-grenfell-tower-cladding-architects-firefighters-experts-reason-why-cause-a7789336.html>
- [4] <http://www.independent.co.uk/news/uk/home-news/london-fire-grenfell-tower-cladding-architects-firefighters-experts-reason-why-cause-a7789336.html>
- [5] <https://archpaper.com/2017/06/grenfell-tower-fire/>
- [6] <https://www.nytimes.com/2017/06/14/world/europe/uk-london-fire-grenfell-tower.html>
- [7] <https://www.theguardian.com/uk-news/2017/jun/14/what-we-know-so-far-about-the-london-tower-block-fire>
- [8] <https://www.standard.co.uk/news/london/grenfell-tower-fire-where-is-it-how-did-it-happen-a3564706.html>
- [9] <http://www.bbc.com/news/uk-40301289>
- [10] <https://www.theguardian.com/uk-news/2017/jun/23/grenfell-tower-fire-police-considering-manslaughter-charges>