

# Journal of Chemical Engineering

Vol. ChE 32, No. 1, April 2024

## Article

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#### To cite the article:

Easir A Khan, “Technical Investigation on Baily Road Green Cozy Cotez Restaurant Fire: Incident Analysis and Lessons Learned”, Journal of Chemical Engineering, IEB, ChE 32 (1), pp. 42-54.



The Institute of Engineers, Bangladesh (IEB)  
Chemical Engineering Division

## Technical Investigation on Baily Road Green Cozy Cotez Restaurant Fire: Incident Analysis and Lessons Learned

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### Abstract:

The Green Cozy Cotez Restaurant fire serves as a unique case study highlighting the catastrophic consequences of fire incidents on commercial establishments in Dhaka City. This abstract presents a thorough investigation into the circumstances surrounding the fire, focusing on incident analysis, fire spread mechanisms, causes of fatalities and deriving essential lessons for fire safety management. Through careful examination of the fire's origins, fire timeline, progression, structural vulnerabilities and emergency response, the study aims to uncover underlying causes contributing to the severity of the blaze and its impacts. The key findings reveal deficiencies in fire prevention measures, building safety standards, regulatory compliance, employee trainings, emergency evacuation and preparedness procedures. Additionally, the study analyzes the deficiencies and actionable recommendations for enhancing fire safety practices in commercial or industrial buildings. The recommended measures include the adoption of national building codes, installation of fire detection and alarm systems, fire protection systems, fire safety plans, emergency escape routes and implementation of comprehensive emergency response plans. By synthesizing empirical evidence with practical experiences, this investigation offers valuable insights and a roadmap for building owners, engineers, architects, interior designers, regulatory authorities, policymakers, business owners, and emergency responders to strengthen fire safety measures and mitigate future risks. Through continuous learning and awareness, communities can enhance their capacity to prevent fire incident in commercial buildings, ensuring the safety and well-being of all stakeholders.

Keyword: Fire Safety, Emergency Evacuation, LPG Hazards, Lessons Learned and Bangladesh

### 1. Introduction

On February 29, 2024, a devastating fire broke out in a seven-story building Green Cozy Cotez in Baily Road, Dhaka that killed 46 people. Dhaka City, the vibrant capital of Bangladesh, is characterized by its busy streets, dense population, and rapid urbanization. With its over-crowded areas, informal settlements, and inadequate infrastructure, the city faces significant challenges in mitigating fire hazards and ensuring public safety. Fire and explosion incidents are very frequent in the city areas in residential buildings, marketplaces, commercial establishment, factory buildings and chemical warehouses[1–9]. Several factors contribute to the increased risk of fires in Dhaka City. Firstly, the city's rapid population growth has led to overcrowding in residential areas and workplaces, increasing the probability of accidents. Moreover, the proliferation of

informal settlements with temporary housing and narrow alleyways worsens the risk, hindering access for firefighting equipment and emergency responders, especially in old Dhaka. Number of deadly fire and explosion accidents occurred in past decades in residential, commercial, and industrial buildings in old Dhaka. In 2019, a fire and explosion incident occurred in a chemical warehouse, 1<sup>st</sup> floor of wahid mansion in old Dhaka where huge amount of flammable chemicals was stored. Consequently, a fire massive fire engulfed the nearby roads as the chemicals spread all over after the explosion. 71 People were killed in the accident who stacked there due to the heavy traffic in the narrow road[1]. The devastating fire sparked by a LPG release and explosion had gutted the Prime Pet and Plastic Industry factory that killed 22 people. Workers who stayed inside the factory were unable to evacuate and burnt to death. According to a survivor fire broke out close to where eight cylinders of inflammable gas were stored.

The lax enforcement of building codes and safety regulations allows for substandard construction practices, improper interior design, faulty electrical wiring, and improper storage of flammable materials, further amplifying the fire risk[6]. The consequences of fire incidents in Dhaka City are very severe and far-reaching[10]. The socio-economic impact is particularly severe for workers, small businesses, building residents who lack insurance coverage and financial resources to recover from such disasters. The release of toxic fumes generated from fire pose long-term health risks for residents and populations who are exposed. There are various challenges in both preventing fire and responding to fire incidents. Weak institutional capacity, limited resources, and inadequate training for firefighters impede effective emergency response efforts. Additionally, the lack of public awareness about fire safety practices, fire safety education and evacuation procedures leave residents vulnerable in the event of a fire. Moreover, corruption and bureaucratic hurdles hinder the strong enforcement of building codes and safety regulations, perpetuating the cycle of risk and recurrence of deadly accidents.

In major fire accidents, the investigation committee formed by the regulatory bodies came with the immediate causes of the events[1]. The root or underlying causes of the incidents were often ignored and had not been surfaced. Unfortunately, the similar events or accidents are recurring. This study conducted a careful technical investigation of deadly incident of Green Cozy Cotez restaurant fire to identify the underlying causes and find out the deficiencies in fire prevention measures, building safety standards, regulatory compliance, regulatory enforcement, employee trainings, emergency evacuation and preparedness procedures. This study also shares the investigation findings and lesson learned from the fire incident and identifies the key stakeholders' roles and responsibility in effective management of building fire safety and provide recommendations for preventing the recurrence of similar accidents.

## **2. Incident Description**

Green Cozy Cotez was an attractive place for food lover at Baily Road located in Dhaka City. The building has number of reputed restaurants in its each floor; chumuk coffee shop and mezbany khan at ground floor, Khacchi vai restaurant at 1<sup>st</sup> floor, ready-made garments showroom at 2<sup>nd</sup>

floor, khana and fuku restaurants at 3<sup>rd</sup> floor, Pizza inn at 4<sup>th</sup> floor, Zesty and Street Oven at 5<sup>th</sup> floor, Hakka Dhaka at 6<sup>th</sup> floor and Ambroshia restaurant at the rooftop.

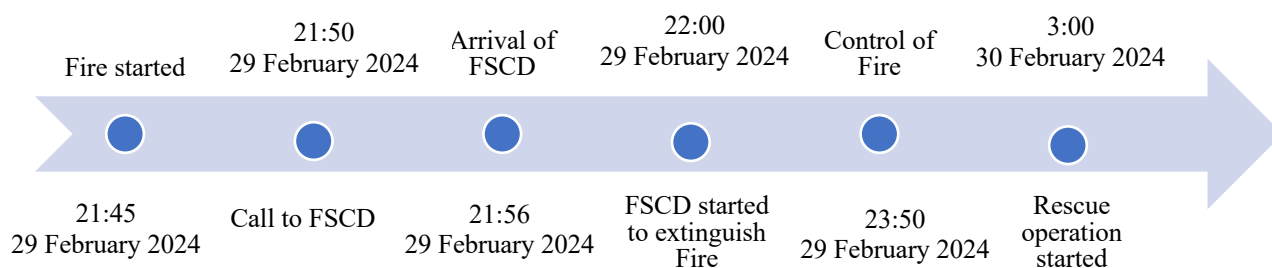


Figure 01: Incident timeline of Green Cozy Cotez Restaurant Fire (Thursday at 21:45, 29 February 2024)

On 29 February 2024, fire initially started at the ground floor at around 9:45 pm local time (BST) and quickly spread all over the building. The incident timeline is shown in Figure 01. Fire service personnel reached to the scene quickly and started to extinguish fire. However, fire spread very quickly to the whole building before the fire service personnel came. Fire initiated at the chumuk coffee shop located close to the main entrance as shown in Figure 02 building layout. The building has two lifts and one staircase which completely blocked by smoke and heat immediately after fire started. The people at upper floor were trapped in the fire and unable to evacuate and consequently 46 of them died because of direct burn injury, oxygen deficiency and/or smoke inhalation.

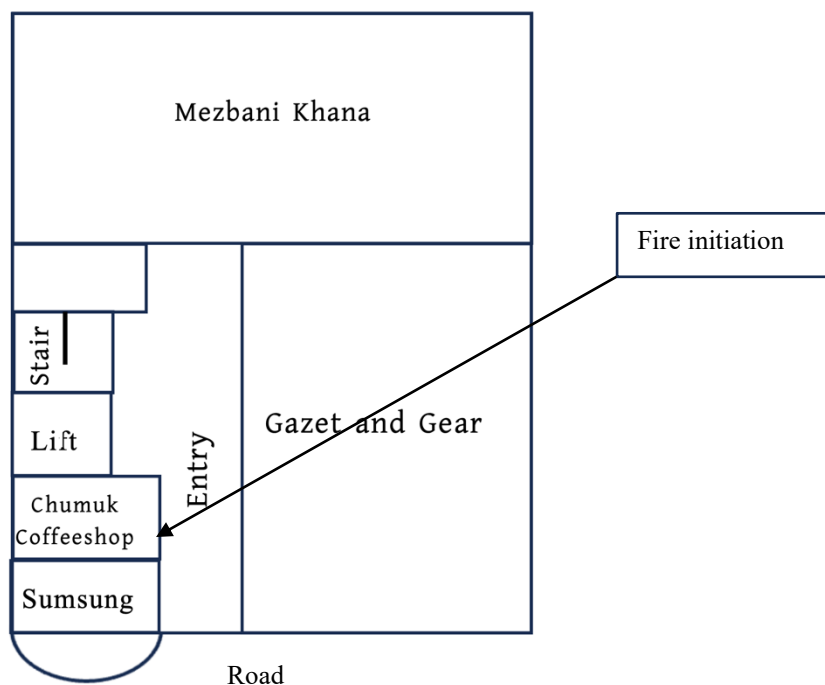


Figure 02: Ground floor layout of Green Cozy Cotez Restaurant



There was no fire alarm system that could be activated to sound in case of an emergency or fire. People were unaware of the fire and its possible risk. Some quickly realized the danger, took the staircase, and get shelter at the rooftop. Within fifteen minutes of the fire starting, firefighters arrived on the scene. The location of the fire source, initial fire scene and smoke spread can be seen in Figure 03 where people were trying to extinguish. People who died were mostly from smoke inhalation and lack of oxygen due to the fire. Out of 46 deaths, only three were due to burn. Approximately seventy-five people were rescued by firefighters from the rooftop. In the early stages of the fire, people used ladders to escape by breaking the first floor's window glass. However, as the fire suddenly became more intense, many could not escape through the windows.



Figure 03: Location of fire source, initial smoke, and fire scene

### 3. Technical Analysis of the Fire Incident

#### 3.1. Causal Analysis of fire initiation and fire spread:

According to early stage video analysis and eyewitness and fire service personnel interviews, the fire started on the ground floor of the Chumuk Coffee Shop, close to the main door. The precise reasons behind the fire's start remain a mystery. A number of factors, including electrical short circuits, electric heaters, gas leaks, and electrical equipment, can contribute to the start of a fire. LPG gas cylinder was used for cooking at Chumuk Coffee Shop.

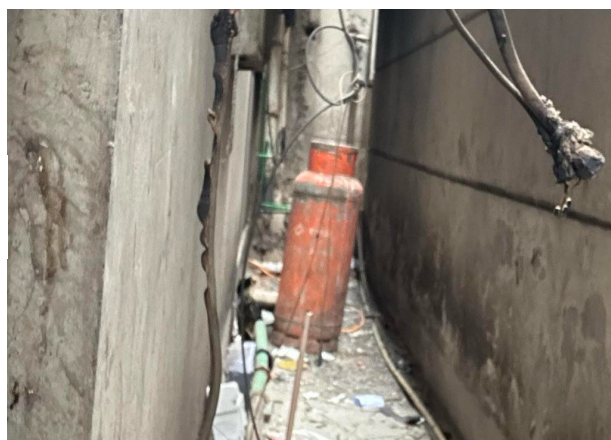


Figure 04: LPG Gas cylinder used in Chumuk Coffeeshop

There was no cylinder inside the coffee shop. As seen in Figure 04, an LPG cylinder was discovered behind the coffee shop and linked with a hosepipe through the wall. This type connection is inherently hazardous. This line will get damaged and leaky in the event of a fire, which will make the fire worse. As a result, if there is a constant flow of gas because of a leak or pipeline failure, the fire will spread very quickly.

Analysis of the video footage shows that smoke was first observed spreading at the ground floor's main entrance. Afterwards, because of the open area and oxygen availability at the front side of the building, the fire and smoke spread quickly there. The direction of the combustion flame is determined by the availability of oxygen. Even the fire didn't spread in Mezban Khana which is located at ground floor and backside of the building (see Figure 01). In addition to the main entrance, the staircase near the Chumuk Coffee Shop is another point of entry for fire in the building's interior. Smoke and fire swiftly filled the staircase and used it as a chimney to spread. As a result, those who had stayed on the upper level were trapped and were unable to escape using the only stairway that was available. Before the fire fighter arrived at the scene, the fire had reached the flashover stage. Fire spread from ground floor to top floor within 2 minutes as shown in Figure 05 (Left- fire scene at the ground floor before the fire fighter came, Right-fire scene just after two minutes).



Figure 05: Fire spread within two minutes from ground floor to top floor.

### 3.2. Causal Analysis of fire intensity and smoke spread:

The fire soon reached the flashover stage and quickly spread from the bottom to the top. The building's front side was primarily affected by the fire, with glass partitions breaking apart. Currently, the two most important questions are: (i) What was in the coffee shop that caused such a catastrophic fire? and (ii) How did the fire spread so quickly? Usually, presence of highly

flammable may create such kinds of catastrophic fire scenario. The presence of an LPG cylinder connection, a highly flammable material, a continuous flow of LPG gas into the fire might have devastating consequences due to the high burning rate and significant energy released when burning. Therefore, this tragic fire may be consequence of continuous release of LPG gas due to pipeline failure or presence of gas cylinders in proximity of fire areas. LPG gas cylinder was stored haphazardly inside the building even at the only available staircase as shown in Figure 06.



Figure 06: LPG cylinders stored at the staircase (Left) and gas line connection using flexible plastic pipeline (Right)

The staircase became filled with smoke and fire. In the staircase, there were over 10 42 kg LPG cylinders. The pressure increased because of the heating of these cylinders. When an LPG cylinder encounters heat and flames and its temperature increases to 70 °C, its pressure also increases to 25 atm. Because of the extreme pressure, the cylinder's relief valve activates for preventing an explosion and releases gasses that fuels the flames. Additionally, cylinders were kept outside the building and connected using flexible plastic tubes (see Figure 06). These pipelines can damage in contact with the flames, can continue to supply fuel which would feed and exacerbate the fire.



Figure 07: Damaged staircase due to excessive heat (L) and damage doors due to fire (R)



The intense heat produced by the fire, which was caused by cylinders kept inside the stairs, severely destroyed the staircase. As seen in Figure 07, the fire also readily burned through the doors on each story, creating a space where smoke and flames could spread. Due to the irregular fuel load on some floors, the fire didn't go very far, but smoke filled the building's enclosure and nearly every floor.

### 3.3. Causal Analysis of Injuries and large casualties:

The majority of the victims in this fire catastrophe were caused by the poisonous smoke that the fire produced. In the early stages, the only possible escape route was obstructed by smoke and flames. There is no safe way out of the building in an emergency. People couldn't use the staircase to get out, not even on the first floor. Some people used ladders to escape after breaking through the front window glass frames. But the fire also produced too much radiant heat, which made it difficult to leave the area with a ladder and trapped inside. The room was filled with smoke even though there was no fire. The same thing was seen on every floor of the structure. As a result of the environment's low oxygen content and smoke inhalation, people passed out. Oxygen is consumed by fire, lowering the enclosure's oxygen content.

Toxic gas is produced by incomplete combustion of the building materials, which include plastic, wood, foam, and interior design elements. Reduced levels of fire oxygen in an enclosure slow down the rate at which the combustible materials burn and result in incomplete combustion. Hence, dangerous volatile organic compounds (VOCs), dust particles, and hazardous gases (such as cyanide and carbon monoxide) are all present in the smoke produced by the fire. Many became quickly unconscious due to the exposure of toxic gases and oxygen shortage, and consequently passed away from cardiac arrest and respiratory failure. In case of oxygen exposure below 10%, people became unconscious very quickly. Table-1 shows the effects of oxygen deficient environment for human exposure.

Table-1: Effects of Oxygen-Deficient Exposure

Oxygen concentration	Effects of Oxygen-Deficient Exposure
21%	Normal as outside air
19%	Some adverse physiological effects occur, but they may not be noticeable.
15-19%	Impaired thinking and attention. Increased pulse and breathing rate. Reduced coordination. Decreased ability to work strenuously. Reduced physical and intellectual performance without awareness.
12-15%	Poor judgment. Faulty coordination. Abnormal fatigue upon exertion. Emotional upset.
10-12%	Very poor judgment and coordination. Impaired respiration that may cause permanent heart damage. Possibility of fainting within a few minutes without warning. Nausea and vomiting.
6-10%	Nausea and unconsciousness.
Less than 6%	Inability to move. Fainting almost immediate. Loss of consciousness. Convulsions. Cessation of breathing followed by cardiac arrest.

#### **4. Underline causes of the incident.**

The green cozy cotez building's ground floor is where the fire originated. The National Building Code classifies this building as a high occupancy commercial building. Because of how it was used, the building was riskier or more vulnerable. Furthermore, the building's numerous levels of fire safety flaws contributed to the accident's catastrophic outcome. These shortcomings or primary causes of this fatal event are addressed in the sections that follow;

##### **4.1. Fire Protection System and Regulatory Enforcement:**

Green Cozy Cotez is a business building with a high occupancy rate. The fact that there were several restaurants housed in the same building increased the danger and risk. The building's fire safety system is extremely inadequate. In compliance with the National Building Code, its lacking internal fire suppression system. There was no regulatory enforcement at all. Numerous agencies responsible for enforcing regulations (such as the Fire Service and Civil Defense, the Explosive Department, the City Corporation, Rajuk, etc.) have certified and granted licenses to this business organization despite failing to address safety deficiencies and violation of code and standard.

The building lacked adequate fire extinguishers. The impacts of this tragedy could have been significantly decreased if the building had an emergency exit and people had been alerted at early stage of fire. The fire and possible risk of the event were unknown to those on the upper floor. The building features a single, unprotected stairway that lacks fire doors. Furthermore, LPG gas cylinders were kept at the staircase.

##### **4.2. Building Construction and Interior Design:**

The authority, RAJUK gave its approval for Green Cozy Cotez to be built as a mixed-use commercial building, with residential space on levels 6 and 7 and business space on levels 1 through 5. Nevertheless, the building was used for business purposes, with an industrial/commercial kitchen occupying most of the floor and a rooftop expansion. The fundamental fire safety concept and requirement has been deliberately ignored by the building's architect, construction company, structural engineer, interior designer, commercial institution, and regulatory or enforcement authorities. The building differed from its original plan even though it had safety flaws when it was designed.

The building featured a narrow entrance, with small and large businesses on either side. The Chumuk coffee shop was located at the entryway, narrowing it further despite not having regulatory agency approval. Interior designers severely disrupted or harmed passive fire safety issues (i.e. fire separations, horizontal and vertical fire separation, introduction of combustible/plastic materials, compartmentalization) as a result of the restaurants' floor-by-floor beautifying. The interior designer installed a thin glass wall to take over the extended and communal areas, demolishing the inside wall in the process. The primary method of fire spread between floors was the breaking of external glass barriers. The building's first and fourth floors, where the vertical fire separation is less than two feet, had extensive fire damage as shown in

Figure 08. This is also supported by the fact that fire didn't spread at the 2<sup>nd</sup> floor as there exist vertical fire separation by solid walls. Therefore, with correct design, the consequences could have been reduced if the fire and smoke had been contained at the ground floor.



Figure 08: Damaged building and exterior glass wall

#### 4.3. Gas Cylinder storage, Installation, and User Awareness:

LPG gas cylinders were used in Green Cozy Cotez's commercial kitchen. Because LPG is a highly flammable and dangerous gas, there is a significant risk of fire and explosion. When installing, using, and storing LPG gas cylinders, the building's business owner neglected to consider the possible risk. LPG cylinders were haphazardly stacked at the building's stairwell. During installation, substandard pipelines and connections were employed. As seen in Figure 06, long, flexible plastic pipes rather than metal ones had been employed to link the commercial kitchen to the bank of cylinders kept outside the building. In the event of a fire, these flexible plastic pipes damage and helped to feed the fire with a steady flow of extremely combustible gas. The severity of the fire and its rapid spread suggest the possibility that the continuous supply and presence of LPG gas had a role in this tragic tragedy.

#### 4.4. Fire Safety Plan and Emergency Evacuation:

The business owner of Green Cozy Cotez failed to address the fundamental safety requirements of the building, employee training on fire safety, fire safety awareness, safe passage during emergencies, and fire emergency responses. Workers received no training on what to do in the event of a fire, where to seek shelter, or how to evacuate. Some workers lost their life after jumped off from the building. The first floor witnessed many casualties as people were suffocating in a locked air-conditioned room after getting trapped within. If they took shelter in the kitchen store area of first floor, which was open to the air and devoid of smoke and fire, their lives might have been saved. Many lives could have been saved if there had been an appropriate fire safety and evacuation plan.

### 5. Findings and Lessons learned.

The fire at the Green Cozy Cotez restaurant was a tragic and fatal incident. There are always lessons to be learned from accidents. An extensive investigation has been conducted into this event in order to identify the root causes, flaws in the fire safety systems, noncompliance, and lessons learned. The key findings and takeaways from the incidents covered in this part are listed below.

- a) Building should be constructed as per occupancy and following national building code. In case of mixed occupancy building, emphasis should be given in designing and implement active and passive fire protection systems.
- b) There must have fire safety plan, fire alarm and safe passage or emergency evacuation route/exits. There must have active firefighting systems and fire extinguisher as per the risk and national building codes.
- c) Fire separation and compartmentalization must not be destroyed during interior design and external beautification. Fire hazard, fire risk and safe passage during emergency has to be addressed in stage of building modifications.
- d) Official and employees must have training on basic fire safety and response plan in case of any fire emergency.
- e) LPG gas cylinder should be handled carefully and stored in open and ventilated area. It should not store in a closed space, in emergency exits or staircase and, in an area, where fire risk is high. Substandard connection and pipelines should not be used for gas line installations to avoid risk of gas leakage and potential accident. Metal standard pipeline should be used instead of flexible plastic pipe for gas line connections.
- f) Regulatory agencies must implement the codes and standards for approval or giving license to the business owners. Accidents can be avoided through the effective implementation of compliances and appropriate fire safety system.

## 6. Recommendations

The opinions and suggestions for enhancing Bangladesh's fire emergency management and safety procedures are discussed in this section. In order to manage fire safety effectively, nations must delve deeper into the issue and adopt a comprehensive strategy for enhancing practices and procedures in a number of areas where they have identified significant shortcomings. To achieve effective management connected to fire safety, one needs investigate several areas, such as stakeholder participation, fire safety standards, guidelines and regulations, regulatory enforcement, fire prevention strategy, fire safety education, and safety culture. Everyone has an obligation to ensure fire safety. The needs and areas for improvement from the stakeholders' perspectives are explained in this section.

- i. Building owners:
  - Expert and reputed companies or personnel must be engaged in architectural design and building construction.
  - The design, supervision and monitoring of construction work must be performed by professionals registered in Electronic Construction Permitting System- ECPS.
  - Building architectural and structural design, design approval and fire safety plan must be ensured as per national building code occupancy category.
- ii. Architect and Construction Company:
  - Potential fire risk must be addressed during architectural design and building construction in accordance with occupancy and national building codes.
  - Passive fire protection and means of egress must be ensured during architectural and structure design of the building.
  - Supervision and monitoring of construction work must be conducted by professionals registered in Electronic Construction Permitting System- ECPS.
- iii. Business owners and Users:
  - In case of change in occupancy and design of the buildings, necessary approval and fire safety requirement must be ensured.
  - For any internal and external beautification of the building, fire safety issues must be addressed carefully so that means of egress, horizontal and vertical separation has not been affected.
- iv. LPG distribution Company:
  - LPG distribution company must provide technical service to ensure safe storage, pipeline connection and installation, reticulation system installation through their own technical teams.
  - LPG distribution company must implement national and international standard to manage risk in handling, storage and distribution of this highly flammable gases.
  - LPG distribution company must conduct thorough investigation of each accident and address the safety issues to prevent recurrence of any future events.



- v. Regulatory agencies:
  - Regulatory agency must check the design carefully as per occupancy and national building code to provide approval of construction.
  - Regulatory agency must ensure monitoring and supervision of construction work as per national building code and approved design.
  - Regulatory must ensure fire safety plan and appropriate fire protection system as per occupancy to provide license to building owners. In case any changes in the occupancy of an establishment, regulatory agency must be informed and provide approval based on the implementation and requirement of appropriate fire protection system to manage fire risk.
- vi. Relevant ministries and law enforcement agencies:
  - Establish Bangladesh Building Regulatory Authority (BBRA) to coordinate, monitoring and implement of compliance of national building codes.
  - Develop standard and appropriate guidelines for safe use, storage, reticulation systems, connections and fittings and safe installation guidelines.
  - Establish a national accident investigation board to conduct thorough investigation, identify root causes of the accident, share lesson learned and prepare recommendations for each stakeholder to prevent future accidents.

## 7. Conclusion

The baily road Green Cozy Cotez restaurant fire is a shocking and preventable accidents. With appropriate protection system, fire safety plan, fire alarm and emergency exit, the accident could have been avoided. The fire risk in Dhaka City requires a multi-faceted approach encompassing policy reforms, community engagement, and infrastructure improvements. Firstly, stringent enforcement of building codes and safety regulations is essential to prevent substandard construction and ensure compliance with fire safety standards. Investing in modern firefighting equipment, training programs for emergency responders, fire safety awareness and establishing fire stations in strategic locations can enhance the city's emergency response capabilities. Moreover, public awareness campaigns, school curriculum integration, and community-based initiatives can educate residents about fire prevention measures, evacuation protocols, and the importance of maintaining fire-safe environments.

The fire risk in Dhaka City presents a formidable challenge that requires concerted efforts from government authorities, urban planners, building owners, businesses entities, and community stakeholders. By addressing the underlying causes, strengthening emergency response mechanisms, and fostering a culture of fire safety awareness, Dhaka can mitigate the devastating impact of fires and enhance resilience against future incidents. Through collaborative action and sustained commitment, Dhaka City can emerge as a safer and more resilient urban center for its residents.

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