

Research Article

# Operational Assessment of Fire Safety Status of Existing Commercial Buildings at Birtamode, Jhapa, Nepal

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DOI: <https://doi.org/10.24321/2456.9925.202202>

## I N F O

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### How to cite this article:

Lama S, Mishra AK. Operational Assessment of Fire Safety Status of Existing Commercial Buildings at Birtamode, Jhapa, Nepal. *J Adv Res Const Urban Arch* 2022; 7(3&4): 9-24.

Date of Submission: 2022-08-20

Date of Acceptance: 2022-09-30

## A B S T R A C T

The study was carried out to analyze the current fire safety status of existing commercial buildings at Birtamode, Jhapa. This research is focused on two commercial buildings; Hanuman Central and One stop mall (Birtamode, Jhapa). These building are selected for research as both of the buildings are considered as largest shopping malls and they also vary in planning and construction technology.

Standard fire safety status check was done with comparing with NBC 107:1994. A standard check list was prepared and compared with current status of buildings. Data was collected from site visits with check list and key informant interview.

During survey of the existing commercial building it was found that not all the guideline mentioned in NBC 107: 1994 was followed. Many aspects of door detailing and stairs detailing were considered in Hanuman Central whereas in case of one stop mall staircase was narrow. Design aspect of Hanuman Central was found more advanced. There were four Exit route however only two of them lead to open space. One escape route lead to basement parking and another was behind the building from where street was nearly 300 m far. Semi enclosed stairs were present in all four buildings. No proper signage of exit was found. One stop mall seems to be more prepared and concerned about the fire safety. Smoke detector, dry powder extinguishers was found in working condition. Water hose reel was installed but was not functional as water tank was not operational and also lack of trained manpower was main problem there. It had four exit, two staircase and two escalators.

**Keywords:** NBC 107: 1994, Compliance, Fire Extinguisher, Water Hose Reels, Standards

## Introduction

Fire is the exothermic chemical process of combustion in which a substance is rapidly oxidized, releasing heat, light, and a variety of reactive chemicals. Accidents, deliberate igniting, and equipment failure are all possible causes of

fire. In today's electronic environment, fires caused by malfunctioning electrical equipment and power distribution systems are on the rise. Electrical fires are caused by faulty, modified, or unapproved electrical equipment, as well as damaged electrical conductors, plug wires, or extension cables.<sup>8</sup>

One of the most common causes of damage in commercial buildings is that residents are believed to be somewhat, if not completely, unfamiliar with the structure. The inhabitants are anticipated to be mobile and capable of self-preservation, but may have difficulty discovering and walking to exits in an emergency due to crowding and unfamiliarity. In addition, the display of merchandise can have a higher fire growth rate than other types of businesses (International code council, 2009).

Due to rapid urbanization and haphazard development, there is more probability of fire in urban areas. In recent years electricity has been recognized as main source of fire.<sup>17,18</sup> Firefighting also have been main challenge for fire fighters due to lack of access of water, lack of water hydrant, lack of awareness and knowledge, narrow roads, miscommunication etc. According to the United Nations Development Program, the most common causes of fire in Nepal are blackout induced fires caused by house owners' negligence, blackout induced fires caused by accident caused by burning candles, fire was aggravated because access for firefighting vehicles was blocked due to vehicle parking, motorbikes, and street vendors, and electrical short circuits.

Smoke and toxic gases are produced by fire and can be deadly to people who are exposed to them. As a result, there is a need for fire prevention and protection. It is accomplished by delaying the start of the fire to give people more time to flee and for the fire department to arrive at the scene.<sup>19,18,8</sup>

Fire damage causes damage of occupant's life, structural damage and loss of properties.<sup>12</sup> A fire disaster will result in not only property destruction but also life-threatening situations. As a result, extreme caution must be exercised when working with components that have a high danger of igniting a fire.<sup>13</sup>

**Table 1.1 Damage and loss due to Fire: 2021**

No. of death	No. of person injured	No. of house damaged	No. of affected family	No. of incidents
457	1758	11491	18760	12635

(Source: Government of Nepal, Ministry of Home Affairs, 2021)

Fire prevention is a matter of being aware of the factor which causes fire to start, then taking steps to prevent. It need a program of education and supervision of work force, a plan for proper and regular maintenance of plant and equipment and proper location of firefighting equipment which also need to be kept maintain and provided unobstructed access.<sup>2</sup>

## Statement of Problem

When a building catches fire, the spread of the fire is mostly determined by the basic flammability of the

building materials and contents, as well as the structure's architecture. The less time residents have to evacuate a burning structure, the faster it burns As a result, commercial complex needs higher fire safety.<sup>7</sup>

If a fire breaks out, it is important that residents are made aware of the situation as quickly as possible and are aware of the steps they must take to go to a safer area. In addition to the safety of those within a burning structure, the protection of those in nearby buildings is equally critical.<sup>6</sup>

Due to fire hazards, large amount of property and thousands of life are directly and indirectly affected every year in Nepal. As Nepal being a developing nation, undergoing and completed projects under government fund seem to be lacking the safety principles. Safety is a less priority to both the party Employer and the contractor. Although the NBC 107 : 1994 has addressed about fire safety but its compliance has not been assessed yet.<sup>16</sup> The research is crucial for concerned authorities and occupants to understand the current state of fire safety in commercial buildings.<sup>16,20,21,22</sup>

## Objective

The objective is to assess the compliance status of fire safety based on NBC 107 : 1994 of selected commercial building of Birtamode, Jhapa, Nepal.

## Literature Review

### Fire

Fires occur when a flammable or combustible material, in combination with an adequate volume of an oxidizer such as oxygen gas or another oxygen-rich compound (though non-oxygen oxidizers exist that can replace oxygen), is exposed to a source of heat or ambient temperature above the fuel/oxidizer mix's flash point, and is able to sustain a rate of rapid oxidation that produces a chain reaction.<sup>15</sup>

### Classes of Fire

Based on the kind of fuel that is burning, fire is classified as follows. This classification system supports in the identification of threats and the selection of the most effective extinguishing agent.

**Class A:** It involves common flammable materials: wood, paper, and fabric fires are generally slow in nature, and because they are solids, they are easier to eliminate.

**Class B:** Gasoline, fuel oil, and propane are among the flammable and combustible liquids and gases found there. They progress and expand at a rapid speed. The fluid nature of these materials allows them to flow and move. Managing these materials is tough.

**Class C:** It includes motors, appliances, and machinery that are powered by electricity. This fire classification has nothing to do with the type of fuel. The fire is no longer classified as Class C after it has been controlled.

**Class D:** Combustible metals such as magnesium, titanium, and zirconium are involved. These materials are typically difficult to ignite, but once ignited, they produce large fires. Class D Fires are extremely difficult to put out, yet they are quite rare in nature.

**Class K:** It has to do with cooking oils. This is the most recent course.

### Fire in Buildings

The study of fire science has provided insight into the mechanisms of ignition, fire growth, and fire spread, as well as the issues of smoke mobility and toxicity. An understanding of the function of fire science in ensuring fire safety in buildings was gained by considering the crucial stages of a fire in a room or compartment of a building.<sup>14</sup>

### The Chemistry of Fire

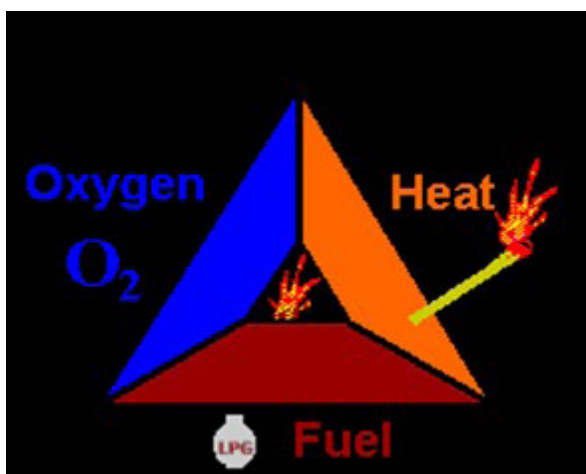
The combination of fuel and oxygen, as well as the application of enough heat to achieve ignition, results in a chemical reaction.<sup>13</sup> The fire triangle describes the chemistry of fire.

### The Fire Triangle

The 'fire triangle' is a basic illustration of the three elements required to start a fire. All materials can be made to burn if given enough heat to allow the molecules to break down and release vapor. When the vapor or gas is released, it ignites, causing more heat to be released, and the fire propagation process begins. The material that remains after a fire has decomposed has less ability to react, leading the fire to die down and go out.<sup>14</sup>

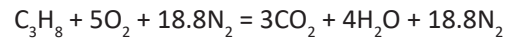
Fire is a chemical reaction requiring:

- Heat (an ignition source)
- Fuel (gas, flammable liquid, timber)
- Oxygen (air)
- Fire Reaction

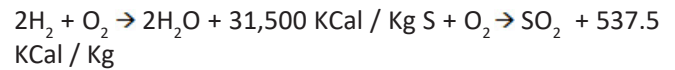
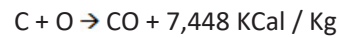


**Figure 1. Triangle of Fire**  
(Source: Furness & Muckett, 2007)

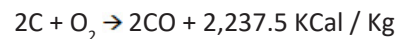
If Propane (C<sub>3</sub>H<sub>8</sub>) is the fuel the reaction is:



Complete Combustion



### Incomplete Combustion



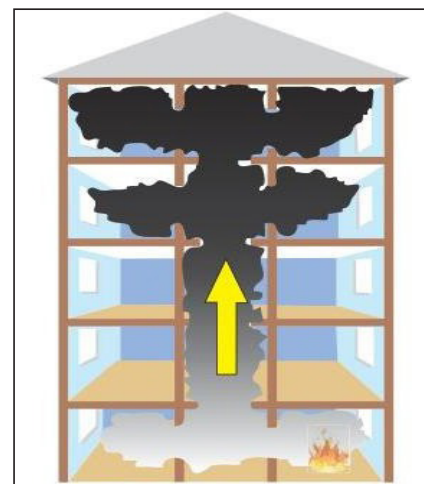
### Principles of Fire Spread in a Building

There are three methods for a fire to spread within a building once it has begun and there is enough fuel and oxygen to keep it going:

1. Convection
2. Conduction
3. Radiation

### Convection

The most typical way for a fire to spread within a building or structure is through convection. Hot gases and smoke air will rise vertically through stairwells, lift shaft risers to the highest level available, and then create a layer at that height, from where they will spread out horizontally until checked. As a fire burns, significant amounts of smoke are produced, which normally spreads ahead of the flames, quickly filling a building. Smoke also reduces vision and obscures escape routes, causing panic and disorientation, which reduces the chances of a successful escape.

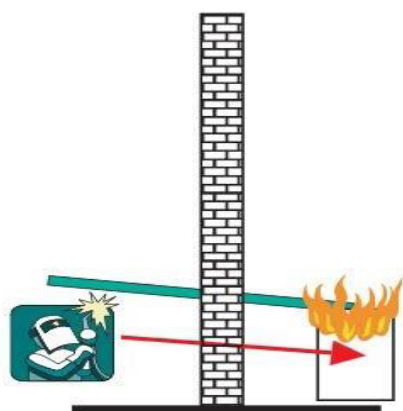


**Figure 2. Smoke Spread: Convection**  
(Source: Furness & Muckett, 2007)

### Conduction

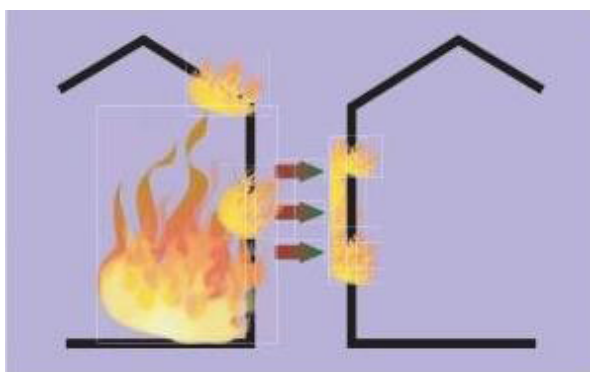
The movement of heat through a material is known as conduction. The ability of conductors to carry heat varies greatly depending on the substance they are made of. Metal, for example, is a far better conductor than masonry.

Conduction can occur in solids, liquids, or gases, but it is most common in solids when it comes to flames in buildings.<sup>4</sup>



**Figure 3. Fire Spread: Convection**  
 (Source: Furness & Muckett, 2007)

## Radiation



**Figure 4. Fire Spread: Radiation**  
 (Source: Furness & Muckett, 2007)

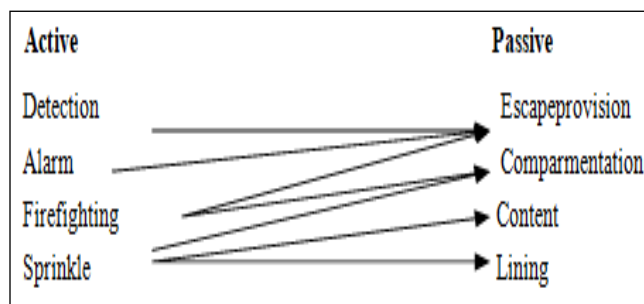
Radiation is the transmission of thermal energy in the form of electromagnetic waves that heat solids and liquids (but not gases) in their path. Fires can spread to combustible things left to dry, or from building to building, when heat from a fire is radiated to a neighboring structure through windows, igniting combustible materials in the second building, as in the case of a heater or open fire.

## Fire Protection in Buildings

The study and practice of minimizing the negative consequences of potentially destructive fires is known as fire protection. It entails research and development, production, testing, and deployment of mitigating devices, as well as the study of the behavior, compartmentalization, suppression, and investigation of fire and related emergencies.<sup>8</sup> Before the environment becomes dangerous, it is critical to provide a chance for the residents to move to a safe location, either inside or outside the building.<sup>11</sup>

Passive and active protections are two major categories of methods that will safeguard people in the case of a fire.<sup>4</sup>

In a building, passive measures like as non-combustible material selection, building subdivision and proper ventilation are present and operating at all times. Active measures include upgrades to a building's services, such as the installation of alarms and detectors.<sup>8</sup>



**Figure 5. Interaction between Active and Passive Fire Protection Measures**

(Source: Furness & Muckett, 2007)

## Passive Fire Protection

The principle of suppression underpins passive fire prevention. The building's compartments are designed in such a way that they can only be used in one location. Fire doors, for example, should keep smoke and flames out of lobbies, stairwells, and lift shafts. The design of escape pathways, which should not include combustible wall, ceiling, or floor linings, is another form of passive fire prevention. Where ducts pass through compartment walls, fire dampers should be fitted, as well as gaps in such walls around cables.<sup>4</sup>

A continuous and uninterrupted line of exit travel from any point within a workplace to a safe location is known as an exit route. Exit access, exit, and exit discharge are the three parts of an exit route. Exit access refers to a section of an exit route that leads to an exit. The term "exit" refers to a section of an exit route that is normally segregated from other regions in order to offer a safe approach to the exit discharge. Escape discharge is a section of the exit route that leads immediately outdoors or to a roadway, promenade, refuge place, public way, or open space having outside access.<sup>4</sup>

## Active Fire Protection

Active fire suppression systems can either detect or extinguish a fire, with a water sprinkler or inert gas flooding system providing both duties. In the early stages of a fire, an automatic fire detection system will detect heat or combustion products and sound the alarm.<sup>4</sup>

## Fixed Firefighting Systems

A building's active protection is provided by fixed firefighting systems (FFS). Provision for FFS can be a compensating element during the design stage to provide additional protection to a wide space or susceptible part of a building.<sup>4</sup>

The most common FFS are:

- Automatic water sprinklers
- Drencher systems
- Flooding and inerting systems
- Water mist systems
- Alarm Systems
- Smoke and Heat Detector
- Water hose reel

### Automatic Water Sprinklers

Automatic water sprinkler systems will provide effective fire suppression in most portions of a building, ensuring safety.

- Fire detection at an early stage
- By delivering water to the fire's heart, you can control its development, spread, heat, and smoke production.
- Operation of the local alarm system and validation of the alarm at the central control room

### Drenchers System

Drencher systems are used to defend against radiated heat or to flood a high-risk process with water to ensure prompt and effective suppression. While a sprinkler system protects a building from interior fire, drenchers are installed on roofs, over windows and other external openings to protect the structure from damage caused by a fire in a nearby building.

### Flooding and Inerting Systems

Flooding and inerting systems work by flooding a specific extinguishing substance into a specific region. Different media, including as dry powder and various gases, are used in these systems. Flooding systems can be used to flood an entire compartment or building, or they can be utilized to flood a fire risk's immediate region.

### Water Mist Systems

Because the heat generated by the fire quickly vaporizes the water mist spray droplets into steam, they may quickly extinguish huge fires in enclosed locations. Small fires that have not yet heated an enclosure or are in broad open spaces, on the other hand, cannot be effectively put out by water mist sprays unless they are physically within the spray's range.<sup>4</sup>

### Water Hose Reels

Water hose reels are made up of coils of hose that are held in place by a sturdy reel and frame. It could be hanging from the wall on hinged brackets or hidden behind attractive panels that fit the decor. They may have a valve for turning on the water supply, or they may be equipped with an automatic system controlled by the reels axle, which turns on the water supply when a few yards of hose have been used up. Depending on the taste or demand, certain hoses are equipped with a plain jet nozzle or a hybrid jet/spray nozzle.<sup>8</sup>

## Alarm Systems

There are various types of alarm systems; they are generally intended to alert people of the need to leave the facility in the event of an emergency.

It may be necessary for someone in the facility to manually activate it, usually through the use of a pull station. The alarm would then sound alarm bells, horns, strobes, or other suitable auditory or visual alarm devices after being manually engaged.



**Plate 1. Fire Alarm**

(Source: Craig, 2002)<sup>1</sup>

## Smoke and Heat Detector

Automatic detection refers to devices on the alarm system that detect the presence of fire, such as smoke and heat detectors. This system can also be set up as a strictly local alarm, in which audible or visual warning devices are activated throughout the facility without the need for an occupant to manually activate them.



**Plate 2. Heat Detector and Smoke Detector**

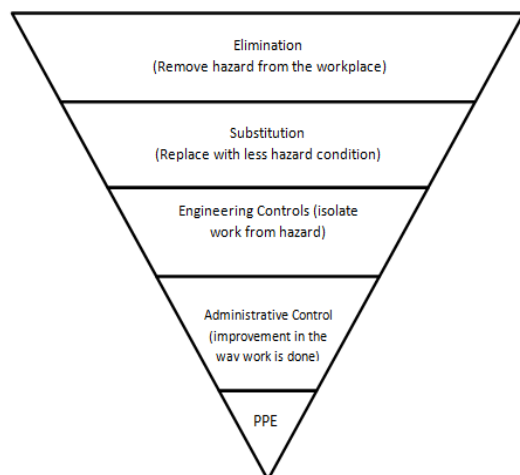
(Source: Craig, 2002)<sup>1</sup>

## Hazard Control

Hazard control hierarchy is a system used in industry to reduce or eliminate hazardous exposure. Several safety organizations support it as a widely acknowledged system. Managers in industry are taught this approach, which is then promoted as standard practice.

The hazard control hierarchy consists of six major approaches to handling hazards.

- Eliminate
- Substitute
- Isolate
- Engineering controls
- Administrative controls
- Personal protective equipment



**Figure 6. Hazard Control Hierarchy**

(Source: <https://www.osha.gov/shpguidelines/hazard-prevention.html>)<sup>14,16, 20,21,22</sup>

This strategy should start at the top and work its way down. In an ideal world, all risks would be fully removed. If deletion isn't possible or practical, which it usually isn't, substitution should be considered, and so on as the list progresses.

**Elimination:** Altering a design to eliminate a hazard; for example, introducing mechanical lifting systems to eliminate the hazard of manual handling.

**Substitution:** Use a less harmful substance or cut the system's energy consumption (e.g. lower the force, amperage, pressure, temperature, etc.)

**Engineering Controls:** Install ventilation systems, machine guarding, interlocks, and sound enclosures, among other engineering controls.

**Administrative Controls:** Safety signs, hazardous area markings, photo-luminescent signs, pedestrian walkway markings, warning sirens/ lights, alarms, safety protocols, equipment inspections, access controls, safe working systems, tagging, and work licenses, among other administrative controls.

**Personal Protective Equipment (PPE):** Safety glasses, hearing protection, and face shields, safety harnesses and lanyards, respirators, and gloves.<sup>10</sup>

## Methodology

### Study Area

To assess the awareness and preparedness of management,

concerned authority and occupants buildings selected were one stop mall and Hanuman Central Birtamode.

### One Stop Mall

One stop Mall is located at Birtamode, Jhapa. It is located at North-west side from mukti chowk (Central part of Birtamode). The building, which is a shopping complex with six stories above ground, was finished in 2016. Three floors including the ground are used for shops and top three floors are used for cinema purpose. Building is U-shaped with a large steel structure at front connecting to building. The structure has a variety of shops selling various goods and services, as well as leisure venues such as a movie, a game center, and a pub. Underground parking facility is also available but the building structural components don't have any connection with the parking below. Vertical circulation is assisted by escalators, elevators, and stairwells, while horizontal circulation is assisted by walkways and lobby.



**Plate 3. One Stop Mall**



**Plate 4. Hanuman Central**

### Hanuman Central

Hanuman central is also located at Birtamode, Jhapa touching national highway (Mahendra Highway). It is also known as Hanuman Complex. It was the first commercial complex build in Birtamode. It was opened in 2012.

It is a rectangular shaped building with atrium in the center. Vertical circulation is aided by elevators and stairwells, whereas horizontal circulation is aided by walkways and lobby. There are 3 staircases in the building with 3 elevators.

## Data Collection

### Observation

Selected study area was visited in order to analyze the current status of fire safety measures and to understand the compliance status of NBC 107 : 1994 in selected commercial buildings.<sup>3,5,16</sup>

**Table 2. Summary of Methodology**

Objective	Activities	Analysis
1. To identify the current fire safety status of selected commercial buildings.	1. Checklist according to NBC 107: 1994 2. Site visit general check list	1. Qualitative Analysis

In this chapter check list of general requirements of fire safety based on NBC 107 : 1994 was prepared and visited to site.<sup>16</sup>

### Comparison of in Field Fire Safety Status with NBC 107 : 1994

Finding from the above mentioned codes has been compared and presented in the.<sup>3,5,16</sup>

**Table 3. Comparison of NBC 107: 1994 with Selected Commercial Buildings**

NBC 107: 1994	One Stop Mall	Hanuman Central
<b>Exit</b>		
1. Evacuation in a short time 2. Meet the minimum requirements of size 3. It must be free of any impediments and give no resistance to movement 4. Clearly visible 5. Preferably with proper signs 6. It must be continuous and not interrupt private space.	1. Every corner is 20 feet away from staircase and escalator. 2. Yes, exit are wide enough (15' wide) 3. Yes 4. Yes 5. No signage was found. 6. 2 exit were open to street and 2 of them were open to private space (one building and one private street)	1. Hard for corner shop 2. Exit leading to back of building and underground parking was found small but the front exit is wide enough 3. Due to parking 2, exit were obstructed and the back exit was far from open street 4. Exit were visible 5. No signage was found 6. Exit were open to own space but only front exit was directly open to street
<b>Staircase</b>		
Min width 1.5 m	1.2 m only	more than 1.5 m
<b>Travel Distance</b>		
Max 20 m	less than 20 m	less than 20 m
<b>Exit door</b>		
1. Open to a passage way or to the corridor 2. Not less than 90 cm width 3. 180 cm height 4. Open outward	1. Yes 2. < 90 cm 3. < 180 cm 4. 3 rolling shutters and one fully open	1. Yes 2. < 90 cm 3. < 180 cm 4. two rolling shutters and two opening inward
<b>Fire Escape or External Stair</b>		
1. Min width 75 cm 2. Tread 20 cm 3. Riser height 19 cm 4. Nos. of riser 15 5. Carry user towards open space	1. < 75 cm 2. > 20 cm 3. < 19 cm 4. > 15 5. Yes	1. < 75 cm 2. = 20 cm 3. < 19 cm 4. > 15 5. Two exit lead to underground parking and one lead to back of building
<b>Signs</b>		
Be clearly visible, preferably with proper signs	No proper Signage	No proper Signage
<b>Firefighting Equipment</b>		
1. Dry riser 2. Wet riser	1. No 2. Yes ( but not functional)	1. Yes (but not functional) 2. No

## One Stop Mall

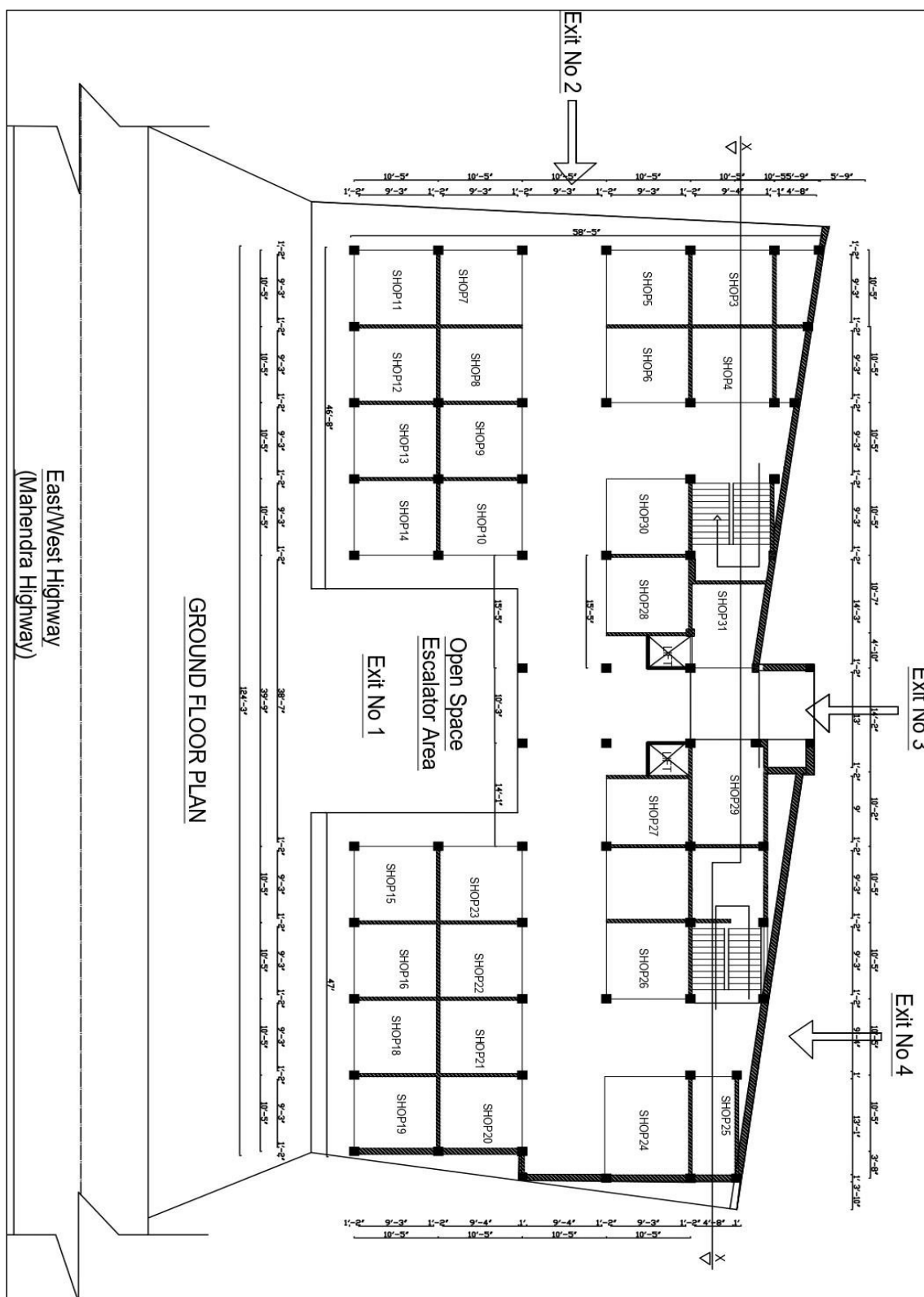


Figure 7. Floor Plan with Exit of One Stop Mall

**Table 4.Compliance Status of BCI07, One Stop Mall**

One stop mall	Exit 1	Exit 2	Exit 3	Exit 4	Remarks
1. No. of Exit					3
<b>2. Stair type</b>					
Enclosed	Yes	No	No	No	Exit 1 open to street connected with escalator
Open at street	Yes	Yes	Yes	No	
Door locks prohibited	No	Yes	Yes	Yes	
<b>3. Doorways</b>					
Open to stair way	Yes	Yes	Yes	Yes	
>= 100 cm width	Yes	Yes	Yes	Yes	120 cm
>=200 cm height	Yes	Yes	Yes	Yes	210 cm
Open outward	No	No	No	No	
No Sliding and overhead door	Yes	No	No	No	
<b>4. Fire escape</b>					
Directly open to ground	Yes	Yes	Yes	No	
Free of obstruction all times	Yes	Yes	Yes	No	
<b>5. Signs</b>					
Proper Signage	No	No	No	No	
Visible	No	No	No	No	
Illuminate	No	No	No	No	

Source: Field survey, 2021

Exit route 1 is located at south which is also a main entrance for building. It is connected with escalator. It opens to East-West Highway (Mahendra Highway). Exit 2 is located at west which is connected to street 20' wide. Exit door is furnished with rolling shutter. Exit 3 is located at north side of building and opens to small Private Street. Exit 4 is also located at north side of building and opens to another building corridor. Management of One Stop Mall seems to be more prepared and aware about the fire safety. It also has a cinema hall in top 3 floor of the building that meets the standard of QFX cinemas. Cinema hall portion has smoke detector and alarm system but water sprinkle system was absent. The material used in wall and flooring of cinema hall was fire resistant i.e. it can resist fire for 2-3 hours. Inside cinema hall there was proper signage placed at different places. Due to its architectural design every corner was closest to the staircase. Staircase seems to be much smaller and narrower compared to standards. Water hydrant system is installed on both staircase but was not functional. Plenty of dry powder extinguishers can be seen in building. Exit route was found free from obstruction but the signage was missing.

**Plate 5.Firefighting Equipment's****Plate 6.Fire Extinguisher and Water Hydrant inside Cinema Hall**



Plate 7. Alarm System



Plate 8. Fire Detecting Board



Plate 9. Exit connected with Escalator front Face

## Hanuman Central

Hanuman central is G+5 storey building. It has 3 staircase, two elevators and 3 exit. It has basement with 1/3 portion underground parking facility. The middle of the complex has wide open space up to top and enough circulation space. Large central area is covered with truss and fully enclosed. For Semi Basement portion there are three entry and exit where two of them at front portion and one of them at back portion. For first floor there are two entrances at front and one at back.

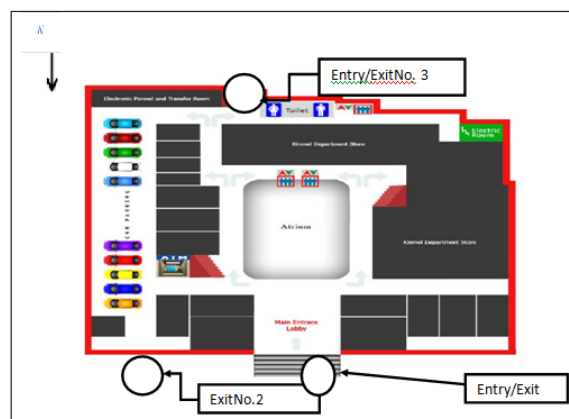


Figure 8. Ground Floor Plan (Semi Basement)



Figure 9. Plan with Escape Routes



Figure 10. Plan with Escape Routes

**Table 5.Compliance Status of NBC:I07; Hanuman Central For (Semi Basement)**

Hanuman Central	Exit 1	Exit 2	Exit 3	Remarks
<b>1.No. of Exit</b>				<b>3</b>
<b>2.Stair type</b>				
Enclosed	No	No	No	
Open at street	Yes	Yes	No	
Door locks prohibited	Yes	Yes	Yes	
<b>3. Doorways</b>				
Open to stair way	No	No	Yes	
>= 100 cm width	Yes	Yes	Yes	120 cm
>=200 cm height	Yes	Yes	Yes	210 cm
Open outward	-	-	-	
No Sliding and overhead door	-	-	-	
<b>4.Handrail height</b>				
Min 100 cm-max 120 cm	Yes	Yes	Yes	100 cm
Gap between two vertical >=30 cm and less than 15 cm				Horizontal division provided
<b>5.Fire Escape</b>				
Directly open to ground	Yes	Yes	No	Open at ground floor and continuous to basement
Free of obstruction all times	Yes	Yes	Yes	
<b>6.Signs</b>				
Proper signage	No	No	No	
Visible	No	No	No	
Illuminate	No	No	No	

Source: Fieldsurvey, 2021

Exit 1 was located at north side of building and opened to Street. Exit door was made up of rolling shutter.

Exit 2 was also located at north-east side of building which leads to semi basement parking. Due to parking the exit seems to be obstructed.

Exit 3 is located at south side of building leading to back

portion of building. The door is connected to staircase. The travel distance from the door to open street is nearly 300 ft.

There are 25 no's of fire extinguishers and also water hydrant system connected from semi basement to the top of the building. There are multiple banks, cooperative bank, play station, food court, and departmental store and so on.

**Plate 10.Exit Door 2 With Semi Basement Parking**



Plate 11.Exit Door 3



Plate 12.Exit Door I

Table 6.Compliance Status of NBC: I07; Hanuman Central For Ground Floor

Hanuman Central	Exit 1	Exit 2	Exit 3	Remarks
1. No. of Exit				3
<b>2.Stair type</b>				
Enclosed	No	No	No	
Open at street	No	Yes	No	
Door locks prohibited	Yes	Yes	Yes	
<b>3.Doorways</b>				
Open to stair way	No	No	Yes	
>= 100 cm width	Yes	Yes	Yes	120 cm
>=200 cm height	Yes	Yes	Yes	210 cm
Open outward	-	-	-	
No Sliding and overhead door	-	-	-	
<b>4.Handrail height</b>				
Min 100 cm-max 120 cm	Yes	Yes	Yes	100 cm
Gap between two vertical >=30 cm and less than 15 cm				Horizontal division provided
<b>5.Fire Escape</b>				
Directly open to ground	Yes	Yes	No	Open at ground floor and continuous to basement
Free of obstruction all times	Yes	Yes	Yes	
<b>6.Signs</b>				
Proper signage	No	No	No	
Visible	No	No	No	
Illuminate	No	No	No	

Source: Fieldsurvey, 2021

Exit 1 and 2 are located at north side of building and opened to Street. Exit 3 is located at south side of building leading to back portion of building. The door is connected

to staircase. The travel distance from the Exit 3 door to open street is nearly 300 ft.



Plate 13.Entry/ Exit I (Hanuman Central)



Plate 14.Entry/ Exit 2 (Hanuman Central)



Plate 15.Entry/ Exit Door 3

### Semi Basement

One third of semi basement portion is used for parking and other part is used for commercial purpose. It has electric panel and transfer room, electric room, generator room and atrium at center. Generators which are source for heat smoke and toxic gases are kept at south-east side and also outside of building.



Plate 16.Water Hydrant

No any trained person was allocated for fire safety of building. The electrical wiring seemed to be in unmanaged condition.



Plate 17.Generatorsat Back of Building



Plate 18.Generatorsat Back of Building



Plate 19.Fire Extinguisher



Plate 20. Extinguisher on Both Sides of Elevators



Plate 21. Unmanaged Electrical wiring

Table 7. Observational Detail

Observation Detail	One Stop Mall		Hanuman Central	
	Exist	Do not exist	Exist	Do not Exist
Halon extinguishers	✓		✓	
Dry powder	✓		✓	
Carbon dioxide extinguishers		✓		✓
(Sprinkler/ Hose reel pressurized water extinguishers)	✓		✓	
Wet chemical		✓		✓
Fire blankets		✓		✓

Emergency communication system (alarm, telephone, mobile no. etc)	✓			✓
Emergency shelters for this building		✓		✓
Availability of an emergency fire disaster kit		✓		✓
Existence of emergency population warning methods		✓		✓
Existence of a fire hydrant		✓		✓
Open spaces for evacuation of people	✓		✓	
Existence of a fire assembly point		✓		✓

## Observation Detail

### Poor Fire Safety Condition

A general checklist for commercial building was prepared and current fire safety condition of building was checked. NBC 107 : 1994 was also followed to check the safety of building.<sup>16</sup> Only fire extinguishers and water hydrant system was found in Hanuman central. In one stop mall fire extinguisher, water hose reel, smoke detector, fire alarm system was also found. One stop mall seemed more prepared and safe in terms of fire safety as the exit way like (both side staircase and front escalator) was equidistance from every part of building. Staircase was narrow as compared to standard. Presence of International Standard QFX cinemas in the top of one stop mall has increased the fire safety measures in the building. In case of staircase one stop mall didn't met the NBC 107 : 1994 guideline as it was narrow and steep.<sup>16</sup>

Hanuman central has big atrium in the center of semi basement portion of building which will eventually help the occupants in semi basement floor for safe evacuation. Staircase seems wider and comfortable. Presence of three staircases at three side of the building seems more helpful for the occupants for safe evacuation in case of any emergency. There were 2 elevators but only was on working condition. On the both side of elevators there was 2 extinguishers. Water hydrant system was not in working condition but can be seen running vertically thorough all the staircase. Overhead tank was not installed for water hydrant. There was no any smoke detector and fire alarm. Management seems more focused on financial prospects of building. There was 25 number of fire extinguisher and

more of them were dry powder. No any sign for exit was placed. Emergency number of firefighting was not placed anywhere in the building. There was no any emergency disaster kit placed in office.

## Conclusion

The current fire safety condition of building was found average. Fire safety tools and equipment's installed were seemed insufficient as compared to daily flow of occupants. The existed tools doesn't found in working condition. In case of staircase, staircase in Hanuman central is wider and seems to follow NBC 107 : 1994 detailing.<sup>16</sup> Fire extinguisher was found in both building as the major equipment's fire safety. Management seems more focused on financial part of building (renting the empty space and collecting monthly rent). Smoke detector and fire alarm was found in "one stop mall only". Proper sign for emergency was not installed in both buildings. Hanuman central was designed with atrium but the smoke vent was not considered in the design.

## Recommendation

The concerned authority should focus on following.

- Fire safety code NBC 107 : 1994 should be strictly implemented
- Municipality should develop their own guideline according to the geography and literacy
- Municipality should organize site visit for firefighter to important commercial and public buildings
- Municipality should strictly implement the fire safety code for newly registered buildings inside its area
- The narrow road should be expanded as soon as possible
- New technology should be introduced to firefighter so that they can find exact location, should organize regular training to the fire fighters
- Municipality should organize regular awareness program and seminar using different media
- Municipality should install fire hydrant in front of important commercial and public buildings

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