

# An Investigation on Fire Safety of Air-conditioned Shopping Centers at Dhaka City

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## ABSTRACT

Shopping is an important and essential routine of urban life. Day by day the need for organized shopping centre is gaining importance in our society. The current trend in Dhaka is to accommodate various functions such as office, hotels, apartments etc. along with the shopping facilities within the same structure. These have increased the potential danger of fire hazard in these mixed uses, multi-storied and usually introvert building type. At present a lot of high-rise Shopping Centers have sprung up all over the city. Among them a big numbers of high-rise Shopping Centers have a doubtful facility to fight with fire. The present study intends to examine the deplorable conditions regarding fire safety and high risk environment that exists in the high-rise shopping centers of Dhaka city. This study is based on the literature review focusing on basic concept about fire. Some shopping centers have been taken as a sample for survey to enquiry whether they meet the requirements and regulations for fire safety or not and what extent they are risky in question of fire.

**Key Word:** Fire Safety, Shopping Center

## 1 INTRODUCTION

The word 'shopping centre' can be extended as the place where shops are placed combined and where people can buy things. But in respect of culture, climate, socio-economic condition of different nations and countries the shopping centre may be called as Mall, Market, Bazaar [Bengali name of open market] etc. In our society, the comparative advantages of location, administrative, economic and other functional factors have contributed towards a substantial increase in shopping activities. As a result, in recent years shopping centers and ribbon like retail developments in Dhaka city have boomed often in the most unplanned and indiscreet manner along most of the roads of the city. Thus, they are one of the key physical structures which contribute to give shape the Dhaka city as an uncontrolled urbanization, as they are growing haphazardly with no respect to urban theory, viability, climate and finally without legislation albeit meager.

### 1.1 BACKGROUND OF THE STUDY

The trend of haphazard growth of market places and shopping centers has transformed the 'Tilottoma City' into the 'City of Shops'. Shopping centre in Bangladesh has

experienced an unprecedented growth over the last decade and a half. Before a decade, people are used to shopping on Chawk bazaar[ at old Dhaka], New Market and Gausia market[shopping center at Mirpur Road] etc. But the uncontrolled development, compelling changes in land-use, mostly precipitated by the rapid growth of population in the capital city Dhaka, various industrial and economic activities, short supply of land etc. have resulted in enhanced demand for compact planning of shopping centers. Now shopping centers, along with the shopping facilities, simultaneously serves the civic, cultural and social community needs, thus making significant contributions to the enrichment of the society. This compact and usually introvert building type have increased the use of electrical equipments. A growing number of shopping centers are now air-conditioned along with escalator and elevator facilities. Moreover, the use of decorative materials that are highly combustible has become more popular in the modern shopping centers. These centers attempt to accommodate various functions at upper floors of their multistoried structures but without any consideration for the separation of service facilities and safety measures. Although adequate safety and security including fire measures are prerequisites for enjoying a hazard free shopping environment; collectively they remain the most neglected issue in the context of total urban development in Dhaka city. Therefore, in the absence of safety awareness among users, any type of fire prevention, precaution and control measures about fire are not adopted by the concerning authority. All these contribute to the danger of fire hazards and accident in shopping centers. Today no shopping centre in the developed world could be responsibly designed or executed without any special regard to design for safety and security in all its aspects [The Daily Star, 2006]. On the other hand, shopping centers of Bangladesh have failed to incorporate the factor of fire safety in the overall design process.



Figure 01: Fire in Bashundhara City Shopping Mall

Bashundhara City Shopping Mall [Fig 01] is one of the largest shopping mall complexes in Asia. Fire[13th of March 2009 ] totally burned down the top five floors of the 21-storey office tower, which housed the corporate office of Bashundhara Group, one the biggest conglomerates of the country [Shaif A., 2009]. The ten-storied shopping complex was not touched by fire. Fire in the Bashundhara City shopping mall was not the first one in a high-rise building of our country. In February 2007, a massive fire burnt down all the offices in the 11-storey BSEC building, including the offices of private TV stations NTV and RTV. A lot of questions were asked at that time, but somehow they were forgotten over time. It can be doubted whether lessons were learned from that accident, as we saw a repeat of that at Bashundhara City [Shaif A., 2009].

Fire in this large shopping mall has raised many questions regarding safety precautions of high-rise buildings that have sprung up all over the city and the ability of the fire-fighting forces to cope up with the rapid vertical expansion of the capital city Dhaka.

## **1.2 SCOPE AND METHODOLOGY OF THE STUDY**

The present study intends to examine the deplorable conditions regarding fire safety and a high risk situation that exists in air-conditioned [Focus on shopping at mixed-used multistoried building] shopping centers of Dhaka city studying some selected samples to get an overview. Methodology of the Study is based on the data that has been collected through field survey to get the live experience, photographic information, observational study as well as questionnaire survey and architectural detail documents and secondary data from the literature review. Interviews with the people were also a help to get information on what has been going. All the secondary data has been collected through a detail literature review and by interpreting the data.

## **2 LITERATURE REVIEW**

### **2.1 CAUSES OF FIRE IN SHOPPING CENTERS**

Most fires in multi-storey shopping centers are caused by the increased use of electrical and mechanical equipment which cause:

- Ignition of combustible materials by heating equipment.
- Ignition of flammable liquids and gases from leaking pipes and ducts by electrical energy etc.
- Defective or improperly installed and operated electrical and heating equipment and services.
- Wiring faults, friction and static sparks.

The most common causes of fire in public buildings like shopping centers are-

- Smoking materials and matches.
- Defective and improperly operated heating equipment.
- Careless disposal of ash and waste products.
- Repairs and alteration hazards.
- Exposure from other buildings from fire.
- Increased use of combustible materials for decoration in modern shops.
- Fire develops easily in enclosed air-conditioned area, etc.

Besides these Narrow staircases, lack of regular fire drills and security measures, improper storage facilities, lack of sign and symbol, improper security systems, etc. are some of the important causes of the recurring tragedy for panic and injury.

### **2.2 TYPES OF FIRE HAZARD**

Fire hazards in shopping centers may be either-External or Internal. External hazard means the risk of fires spreading to adjoining or nearby buildings. In the case of shopping centers of Dhaka city, external hazard could be a risk of fire spreading adjoining or nearby building as the shopping arcades do not provide the minimum setback from the adjoining building. Therefore externally fire may spread through windows or openings.

Internal hazard includes -The fire load, the ease with which the combustible materials are set on fire, the rate of burning, the ability of materials to emit noxious fumes when heated and encourage the burning of other materials.

## 2.3 SAFETY MEASURES

**2.3.1 Fire prevention:** Safe installation and routine checking of electrical systems, the provision and maintenance of fire fighting equipments, Buildings, with noncombustible construction and surface finishes, the dumping of flammable rubbish, etc. are important issues for fire prevention.

**2.3.2 Fire precaution:** Objectives of fire pre-cautions:

- Measures should be taken so that the possibilities of fire occurring are lessened.
- The provision of adequate facilities to enables the occupants of the buildings to escape safely and quickly in case of fire. Containment of fire within the buildings and to reduce the chances of fire spreading to adjoining Buildings [Mahfuz, M., 2013].

**2.3.3 Fire control:** The measures for fire control have to be provided at the design phase and during the time of building construction. The various measures are:

- **Compartmentalization:** It is a way of keeping a fire relatively small by dividing up a building into fire-tight cells or units by means of fire resisting walls and floors. It is, therefore, necessary for the multistory building so that the threat develops more slowly. It is essential that the compartment shall survive a burn out of its combustible contents without the collapse of the fire resisting separating elements
- **Refugees:** In multistory buildings it would be difficult to provide a place of safety at the ground level. Moreover, it is impractical to evacuate completely the buildings like shopping centers that house thousands of people of the time required, and in such cases it is better to provide a place of safety within the building. Such “refuges” are constructed so that they are free from smoke and fire.
- **Fire alarm and Detection:** In case of fire, the most primary necessity is to detect fire and to raise the fire alarm. To reduce the loss of life and property it is obviously important to detect the location of fire as early as possible, therefore the alarm should be raised manually or automatically, to warn both the people and the fire fighters.
- **Smoke vents and screens:** Experts has pointed that, now a day’s rather than flame is the primary threat to life in case of a fire incident. Because smoke creates the panic [ and animal like stampeding that widely excited people crush each other to death] situation among the fire effected people by obstructing visibility. Most of people by fire in buildings have fears not to find an exit because of smoke, and have letter been poisoned by carbon-monoxide gas or suffocated by oxygen deficiency. Therefore, if the escape routes remain completely clear from smoke then the people would not be panicked.
- **Other fire extinguishers:** Fire extinguishers should be chosen depending on the severity of the fire. The common extinguishers can be both portable and fixed. Portable fire extinguishers can be divided into five groups[Extinguisher service- GWF Services] namely:
  - water extinguisher
  - carbon dioxide extinguisher
  - vaporizing liquid extinguisher
  - dry powder extinguisher
  - foam extinguisher

## 2.4 MEANS OF ESCAPE

It is the first and chief need and the one with the most impact on building design.

When designing escape routes or accessing their efficiency the following factors should be kept in mind:

- 2.5 minutes for evacuation time is recommended by the fire grading committee (UK).
- Sufficient numbers of exit with adequate capacity should be located with convenient paths of access and adequate lighting of exits.
- During the length of fire hazard all the exits should be protected from fire and smoke.
- Escape routes are desirable to be direct, unobstructed, and clearly signed.
- The exits should be same width to that of the corridors. The possible discharge rate should be the determining fact for the exit width rather than the total number to be discharged.
- All doors in the escape route should open in the direction of escape and should not be lockable [Fire Doors Bristol]. Final exit doors may be secured with panic bolts.
- The openness of the escape path affects the speed of movement and may be 12.5 meters per minute in corridors and 18 meter per minutes in unconfined spaces. This permits travel distance of 30 meter and 45 meters respectively (that is speed x evacuation time = travel distance). Travel distance is the actual distance traveled by a person from any point within the floor area to the relevant exit that is protected doorway and rather depending on a single plan dimension it must be directly related to occupancy and the use of the floor area.
- Materials which might constitute a fire hazard should not be contained even temporary in any part of a protected escape route.
- In multistoried shopping centers along with low rise structures, the alternative escape is a must and that should be located in the opposite direction of the main route in case the main exit is blocked by smoke or fire.
- It is not advisable to depend on fire brigade because modern traffic conditions and congestion may well delay their arrival.

## 2.5 LEGISLATION RELATING TO SHOPPING CENTERS

In the face of all the existing potential dangers, the Rajdhani Unnayan Kartipakhaya [RAJUK] has been unable to give the matter of fire safety due importance. RAJUK has very meager rules for fire prevention, protection and control in buildings. For buildings above six stories it requires owners:

- To install with instructions for fire extinguishers in open on each floor.
- To provide instructions for quick evacuation of the building with a fire alarm system.

With regard to the Emergency Escape Path RAJUK requires that:

- It should be within 25 meters from any place
- Its lobby should be separated from the lift lobby
- It should be connected to the ground floor.

Recent addition in RAJUK legislation's regarding Fire Safety in Shopping Centers:

- No shopping centre should be located within 200 m of a busy traffic node to avoid congestion at the entry point.
- Setback rules: any shopping complex will have a setback of 1.25 m from the road front only.
- If the back and side walls of a building accommodate openings, then a maximum setback will be 1.25 m.

- If a shopping centre is located in residential area, then a minimum setback will be 1.5 m from the adjacent residence.
- If a shopping arcade has roads on more than one side, then a minimum setback will be 1.5 m from the secondary roads.
- The RAJUK has referred for adequate fire alarm, garbage provision, loading-unloading, etc. but without specifying any standard for different building types.
- Fire Alarm should be installed in each floor of a building of more than six storey height.
- Shopping centers of 7-9 storeys should provide at least one lift and of 10-15 storeys at least two lifts should be provided.

The capital's building authority has virtually no instrument to make even these ridiculously paltry rules effective. Needless to say, the building owners and users violate almost all the rules, making their buildings potential time-bombs for a fire disaster.

### 3 CASE STUDY







Building name	location	Building type	shopping	Adjacent land use	photograph
Karnafuli Garden city	Kakrail road	22 storied shopping cum residential Building	Three storey	Residential and Commercial	
Twin Tower	Kakrail road	22 storied shopping cum residential Building	Three storey	Residential and Commercial	
Navana Tower	Gulshan Avenue	23 Storied commercial cum residential Building	Five storey	Commercial	
Eastern Plaza	Hatirpool	10 Storied commercial Building	Five Storey	Residential and Commercial	
Bashundhara city	Panthapath	20 Storied commercial Building	Eight storey	Commercial	
North Tower	Uttara	18 Storied commercial Building	Five storey	Residential and Commercial	

Table 01: List of Surveyed Shopping Center

#### 3.1 PROBLEM IDENTIFICATION FROM THE SURVEYED BUILDING:

**3.1.1 Basement:** The following situation are observed in almost all cases of surveyed building:

- Careless disposal of waste products in the basement [Fig 02] that increase the risk of ignition of fire
- Absence of daylight in the basement parking which will make fire-fighting difficult.
- In many cases People employed for the maintenance make their living are at Basement.[Fig 03]
- At Navana Tower and Karnafuli Garden City, Generator and in all other cases locations of A.H.U and maintenance room are at basement.

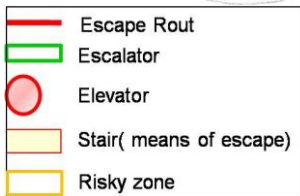
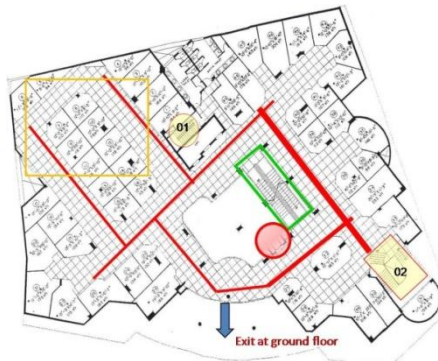


Fig 02: disposal of waste products [Eastern Plaza] Fig03: Used by the occupants [Twin Tower]

**3.1.2 Lift and stair and Fire Escape:** All the shopping centers are providing escalator and elevator for beauty but these are not working in hazardous situation. They do not have notices or signs placed near the entrance, advising passengers on the use of Escalator and Elevator to avoid accidents in case of any danger. Escape route and position of stair and lift are analyzed below [Table 02]

**Karnafuli Garden city**

**Plan**



**Findings**

- Stair 01 is used by the apartment and remained locked at shopping levels. The staircase 02 for market is not protected from fire and smoke as it is not compartmented.[Fig 04]
- Lift lobby not separated from main lobby[Fig 05]
- Escape route is too long for evacuation.



Fig 04: Open Stair

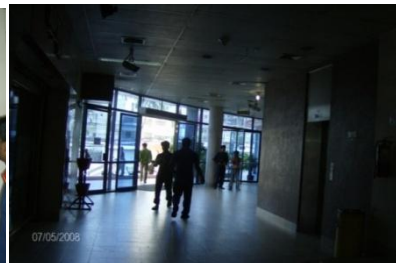


Fig 05:open lift lobby



**Twin Tower  
Plan**



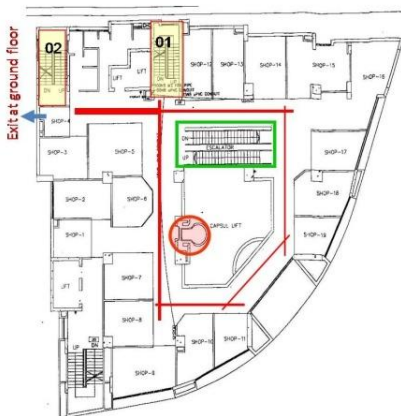
**Findings**

- The only stair also used as fire exit and at ground floor exit space used as security room [ Fig 06].
- Lift lobby not separated from main lobby
- Escape is too long for evacuation in time. And it is not easy to find the stair as it is at one corner of the building



Fig 06: stair and fire exit

**Navana Tower  
Plan**



**Findings**

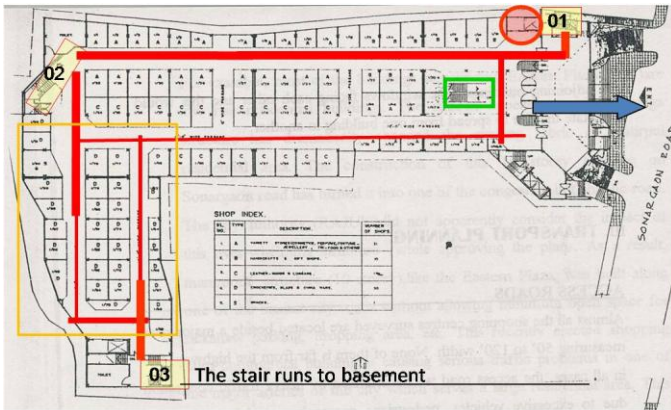
- One stair [01] remains closed all the time and another one [02] act as fire exit but the door remained locked at ground level.
- Lift lobby is not separated from main lobby and also enclosed by shops and their display [Fig 07].



Fig 07: The lift and stair is enclosed by shops display



**Eastern Plaza  
Plan**



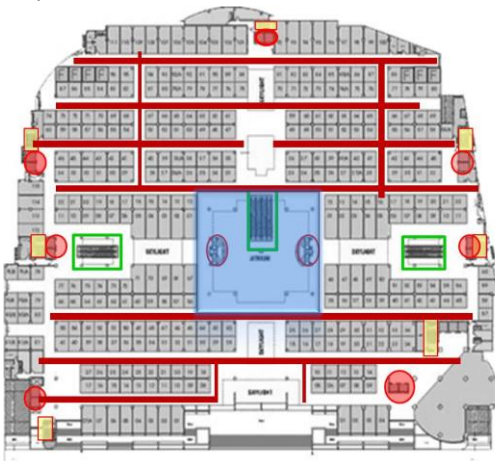
**Findings**

- Lift lobby is not separated from main lobby and the stair 01 is not compartmentalized.
- Stair 02 [Fig 08] reaches at ground floor but it is at the end point of the building.
- Staircases are not easily visible for quick escape in case of emergencies
- The shopping centre is too deep for external fire fighting.



Fig:08: Open stair will be a carrier of fire and smoke

**Bashundhara City  
Plan**



**Findings**

At Bashundhara City all stairs lead to basement parking and act as fire exit and these remained under lock and key almost all the time, which will causes hazard during the fire [Fig 09]. In all cases adjacent lift lobby is not compartmentalized.

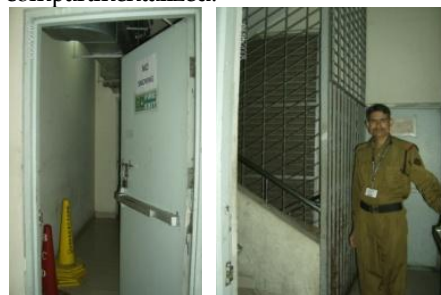
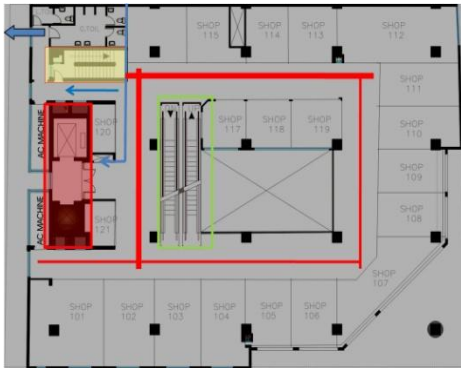


Fig 09: Fire exit controlled by security guard and remain closed at Parking level

**North Tower****Plan****Findings**

- There is only one stair for the whole building. Its width is 3' and act as fire exit. It remains lock all the time.[Fig 10]
- Outside of the fire exit [escape route] remains occupied by wash and maintenance area.



Figure 10: Closed Fire exit and its out side

**3.1.3 Drop Ceiling:** Combustible gypsum boards used as a suspended ceiling material in each shopping mall which increase the risk of fire [Fig 11].



Figure11: Gypsum Board



Figure 12: Use of Fire Safety Signs and Symbols

**3.1.4. Safety signs and symbols:** Most of the centers surveyed the "No Smoking", Fire Exit signs displayed; only 5% have not displayed the sign[Fig 12].

**3.1.5. Fire Fighting Equipment:** Almost all shopping centers are well equipped with a good number of Fire extinguisher and hydrants systems [Table 03, 04]. Fire extinguishers kept in front of elevator, escalator, stair, toilet, and other public gathering space. Smoke detector and fire alarm provided almost 60% shopping centre most of them are ceiling mounted .Sand bucket present only few of the shopping center. We observed the use of fire fighting system of Bashundhara City is best but in case of fire we find that almost all are inactive, which raised a questioned that what is the situation of maintenance of all other cases.



Figure 13: Fire Fighting Equipments

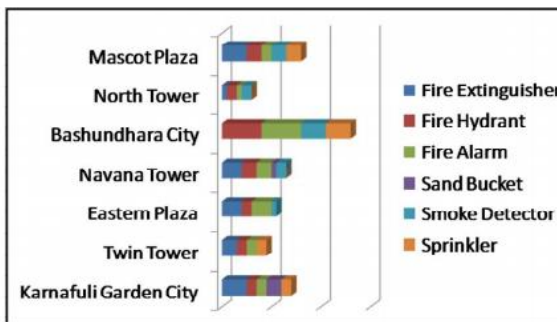


Table 03: Fire Fighting equipments

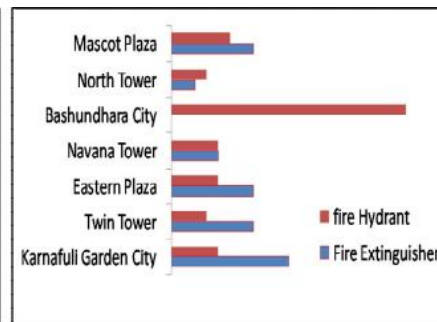


Table 04: Fire Hydrants and Fire Extinguisher

#### 4 OVERALL FINDINGS

From the overall analysis, it is very clear that Risk of fire and fire fighting system is not properly addressed in our country. So that means of escape is not properly work in almost all cases. Besides this, fire fighting equipments found more or less in almost all building. But they are not maintained properly. Bashundhara City shopping Mall, which is in the best position of almost all shopping center of Dhaka City regarding resign and presence of enough fire fighting equipment is observed in this building. Fire-fighters took more than six hours to bring the fire under control, even though the building was said to be equipped with the most modern fire-fighting equipment. However, Fire in this tower raised a lot of questions about the maintenance of the building. Besides these, a lack of proper monitoring of safety precautions in high-rise structures, as well as the fire-fighting capabilities of the Fire Brigade in our country is also observed in this case. Lack of proper equipment and lack of exposure to latest training methods of the Brigade are now being discussed at many quarters.

## RECOMMENDATIONS

Today the shopping centers in Dhaka city are facing the dire need for appropriate fire safety measures, fulfillment of which may not be completely achieved at a time but gradual application of solutions may be possible. In light of the tremendous progress and advancement made in the UK and other developed countries with respect to fire prevention and control in a shopping centre, the formulation of a design criteria for Bangladesh may include the following aspects:

### Escape Route:

- Generally the larger a building will be the more number of accesses should be provided all around it, to ensure immediate escape and enable fire services to fight fire within a dense surrounding.
- The routes should be sufficiently protected from fire and Check that escape routes are not blocked by storing combustible materials.
- Check that escape routes are clearly indicated by exit signs.
- All escapes should have sufficient artificial and emergency lighting.

**Stair and Lift Lobby:** With regard to fire safety design of staircases following measures should be consider:

- Stair should have a direct link with ground level and should not leads to basement.
- Basement should have at least two stairs, unless they are very small.
- Although artificial lighting is a necessity in shopping centers, daylight should be ensured at least staircases.
- Spiral stairs in shopping centers, where large mixed gathering are expected, should be avoided.
- The staircase and the lift core, while considered as means of escape, should be compartmentalized with fire resisting materials. and should be at clearly visible location.
- For multi-storey premises, staircases should not be more than 61 m apart and the route to an alternative protected staircase and exit must not pass through the enclosure of another.
- Stair should follow the standard (tread + riser = 17 in minimum).
- Landings should follow the standard (1.5 x stair width) practice.
- External staircases should not be suggested for escape, as they would become hazardous, in the rainy season.

### Fire Fighting Equipment:

- It is essential that fire detection and fire warning systems should be properly designed, installed, and maintained.
- Routine checks of firefighting equipment should be carried out.
- The fire-warning signal should be distinct from other signals, which may be accompanied by clear verbal instructions. It must be familiar with the shopkeeper.
- All the shopkeepers and security guards should be involved in regular fire drills at least once a year, and they should be trained in the use of fire fighting appliances.

### Other Consideration

- At the planning stage, sufficient foresight is needed regarding site selection.
- Within the shopping centers loading and unloading docks should be designed so as to facilitate smooth running of the different operations
- Setback rules should be implemented and to implement it, effective legislation and means to enforce them should be developed.
- Regular supply of water is must, in public buildings, to facilitate early fire fighting activities.

- Most of the incidents in shopping centers result from short-circuit and unsafe wiring. Therefore, proper wiring as well as regular and continued supply of electricity should be ensured in shopping centers.
- Basically traffic congestion is a function of land use, so the mushroom growth of shopping centers should be controlled under a comprehensive and integrated land use transportation planning in the context of total environmental impact assessment.
- Fire Brigade of our country should need the exposure of latest training methods and should be well-equipped with proper equipment and facilities.

## 5 CONCLUSION

Now it is very urgent to make our people aware about fire hazard. To meet the current challenge, it is high time that government officials and all the concerned authorities take appropriate measures to ensure adequate safety for people at high-rise shopping center. There is a need to develop consciousness among owners, architects, engineers and users that, there is genuine concern about the prevailing situation in legislation regarding fire prevention. Rules should be enacted to enforce design and administrative actions for fire prevention, precaution and control in different building types, including shopping centers. Our Building Codes should address the fire hazard in a more specified form and it is necessary to integrate code requirements with other design strategies to achieve a balanced design that will provide the desired levels of safety.

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