**A Study of Earthquake and Fire Safety of Residential Buildings in Delhi, India**

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**Abstract:**

Buildings are planned, designed and constructed to meet their functional requirements as well as to keep its occupants safe from the impacts of disasters. It has been observed in India, that buildings designed & constructed by public agencies, generally performed well, during previous earthquakes, cyclones & fires, although shares of such buildings among all buildings is much less (about 10%). Privately designed & constructed buildings suffered damages during previous disasters. Now, in most of the urban areas, buildings designed & constructed by public agencies, are going through lots of unauthorized modifications & extensions (by cutting their structural members like beams, columns, slabs and removal of its load bearing walls, whether they are high rise RCC based or low-rise load bearing construction) by their occupants, rendering them vulnerable, as their basic structural systems are being compromised. A case study from the capital of India - Delhi, has been undertaken and it is found that unauthorized modifications/extensions in residential buildings designed by public agencies, is happening at a large-scale and in case of fires or earthquakes, these buildings will also suffer huge damages.

**Abbreviation, Acronyms and Glossary:** BIS: Bureau of Indian Standards; NBC: National Building Code of India; Lal Dora area: Area, where municipal corporations don’t have jurisdiction; NIDM/NDMA/SDMA/DDMAs: National Institute of Disaster Management/National Disaster Management Authority/State Disaster Management Authority/District Disaster Management Authority; IAStructE: Indian Association of Structural Engineers; Building Bye laws: Norms for planning and designing of various types of buildings.

**Key words:** Earthquakes, Fire, Urban Buildings, Design, Construction, Maintenance

1. **Introduction:**

India is severely prone to the occurrence of earthquakes (as more than 65% of its geographical area is prone to medium to severe-intensity of earthquakes as per Indian Standards) and has witnessed several severe earthquakes in the recent past, resulting in the loss of several thousand of human lives and destruction of properties worth several million Indian Rupees (INR) [1-4]. The earthquakes of Uttarkashi (1991), Latur (1993), Jabalpur (1997), Chamoli (1999), Bhuj/Kutch (2001), Jammu & Kashmir (2005), Nepal/Sikkim (2011) and many more, have devasted the local population & infrastructure [1]. India has been seismically mapped and has been divided into 4 (four) earthquake zones by BIS (Bureau of Indian Standards) as Zone II to Zone V, depending upon the probability and intensity of occurrence of low to high-magnitude earthquakes [5-6]. Detailed codes/guidelines have been issued by BIS, to plan, design & construct various facilities in these seismic zones, as per the desired performance of these facilities during their service life span and many of these guidelines have been incorporated into local building bye-laws of many Indian state governments [5,7,8]. In these codes/guidelines, relatively stringent provisions are kept for public & lifeline buildings (and a few specialized structures), as public & lifeline buildings are frequented by large populations and any mishaps in these buildings will result in a big tragedy [5,6,9]. It has been proved time and again that buildings/structures designed & constructed as per these codes/guidelines have performed reasonably well [1]. It is also felt from the lessons learned from previous disasters, that major loss of lives & properties occurred due to non-adherence to these codes/guidelines in the fields and not because of technical flaws in these guidelines, further, these guidelines keep on updating as per the latest scientific knowledge & technology and capacity [2,5,6,9].

However, in practice/fields, we still see construction of many non-conforming buildings to these codes/guidelines and unauthorized/undesired modifications in the structural systems of conforming buildings (structural columns/beams and slabs are cut/punctured to do modifications/interiors/extra construction) coupled with misuse of approved buildings use (residential buildings are converted into shops, hospitals, educational facilities, guest houses, warehouses, etc.) at a large scale everywhere [3,4]. This is happening almost all over India and nobody seems to be bothered about it (as the public at a large scale is involved in these activities and because of its pressures, these acts are either ignored or regularized at a later stage, without analysing its serious effect on infrastructure & disaster resilience of built environment) [1,4]. It is estimated that less than 10% (very rough estimate) of total residential buildings in urban areas are engineered (and they too have gone through major modifications by these unauthorized construction activities, hence these buildings may not be categorized in the engineered category), and the rest 90% (approx.) buildings are non-engineered (especially in Lal Dora areas, Slums and peri-urban areas), which are highly vulnerable and may collapse like pack of cards in case of occurrence of even low to moderate intensity of an earthquakes or fires [ 3,4].

This is a big challenge, as this is happening not because of a lack of planning, designing, or construction knowledge, but because of poor enforcement/monitoring of such construction in the fields [1,3]. It is also happening because public/occupants are also not aware about repercussions of such modifications. In few instances, architects/engineers also help occupants with such modifications. The building stability certificates desired by statuary authorities are also an eyewash, as generally these certificates are issued without any detailed calculations or technical investigations based on established scientific methodology. Further there is no credible competence-based registration or licensing system for civil & structural engineers in India. Although the country is progressing well, yet its infrastructure is still flawed with vulnerability towards disaster risks [1].

In case of an earthquake having a magnitude more than 7.0 (seven) on the Richter scale (at shallow depth, having high intensity), strikes any urban area of India, which generally has very high population density and weak buildings/infrastructure, the damage will be unimaginable [3]. The rescue operations will be severely affected due to narrow approach lanes and the high density of buildings. Our lifeline buildings may not be functional as most of them are not designed for earthquake/fire safety and even if they are designed for these, their utility services like oxygen supply lines and other auxiliary support systems may not be in working conditions after earthquakes or fires [1]. Further, the houses/hostels of the paramedics/doctors and support staff working in these hospitals will also be got affected by the earthquakes/fires, resulting in a shortage of staff. Hence, collateral damages will be much more (which should be taken are off now) [1,3,4]. It is hoped that agencies like NIDM/NDMA/SDMA/DDMAs must have done risk assessments of such situations, specific to cities, and may have prepared a strategy to deal with such situations, and if not done yet, should be done now.

Unlike an earthquake which are mostly natural hazards, fires are predominantly human induced (most of the times in urban areas), which are killing humans & animals and destroying properties [4]. In the recent past, there have been several reported cases of fires in public buildings in national media in India, like a fire in a coaching centre at Surat & Delhi, Hospitals & Restaurants in Mumbai/Delhi, Guest houses in Delhi, Hotels & Factories in Delhi, many residences in Delhi and other cities, etc., where public including teenaged children suffered badly, resulting in loss of many precious human lives [1,10,11]. These buildings were generally not publicly designed/constructed buildings, but were privately owned residential/commercial/institutional buildings taken on either lease or purchased by respective business providers, which are then patronized by public/users/customers/patrons/patients, for the various usages (shops, restaurants, hotels, malls, cinema halls, factories, coaching centres, hospitals, etc.), hence were needed to planned, designed, constructed and maintained with the utmost care, to provide safety to the intended users [3,4]. Concerned authorities are aware of this fact, but remain a mute spectator till some disaster occurs. If students die in schools due to fire or building collapse, then it is not acceptable to any civil society. What is the fault of the people who use these buildings, after paying money (tuition fees, tickets, etc.) believing that these buildings are doing legitimate business as per approved building plans following the legal framework of the country? It indicates that the relevant enforcement agencies are not been able to perform their job well in the interest of public at large. They often wake up only after a disaster and go to slumber again a few weeks after the disaster. What lessons are learned from the failure of much talked about buildings in Lalita Park at Yamuna Riverbank, Delhi, Shahberi village at Greater Noida, U.P., etc. [10,11]? The information related to such failures along with lessons learnt from these events must be shared and disseminated with the affected population and local communities.

India, with a population of 1.4 billion as in the year 2023, is the most populous country in the world [12]. Hence, there are millions of several types of buildings like residential, public, private, institutional, educational, industrial, infrastructural, defence, communication, nuclear, etc., which are used by the population for various purposes. The violations in terms of conformity with building standards in these buildings are huge and alarming [2]. Now, there is some seriousness is noticed out of judicial intervention that a much talked about, high-rise residential buildings in NOIDA, a happening town adjoining New Delhi, India have to be demolished as these were constructed in gross violation of building bye-laws and fire safety laws [13]. Hence, this menace has been noticed and action is being taken in this direction now.

Regarding fires in buildings, these becoming regular features as almost every week, there is a big fire reported in the newspapers from all types of buildings, resulting mainly from three sources, electrical short circuits, cooking gas leaks or hazardous activities inside buildings [4]. The country should increase monitoring of such buildings and take corrective measures at large scale to prevent such mishaps.

In this paper, authors have studied several residential buildings designed & constructed by public/private agencies in the capital of India, i.e. Delhi, for their compatibility with earthquake & fire safety norms and found that several buildings are deficient of these safety features and if any earthquake hit Delhi, the condition of Delhi will be much worse than Turkiye earthquake (2023). It is noticed that generally buildings designed & constructed by public agencies are more resilient, than the buildings designed & constructed by private parties, however since there is a large scale modifications are being done in the buildings designed & constructed public agencies, their performance will be much less than the expected in case of occurrence of earthquakes and fires.

1. **Literature Survey:**

India is a fast-developing economy and has vast technical expertise in almost every walk of life. Building designing is an area, where Indian expertise is the best in the world. Indian building standards are being followed in many countries and in fact India helped many countries in formulating their building standards also [14,15]. The country has a government-supported standard institution named as BIS (Bureau of Indian Standards), which is mandated to formulate standards in various domains including buildings. Standards for buildings, are based on building use, life expectancy, desired performance, geo-hazards, soil conditions, construction materials, climate, materials availability & local socio-economic conditions etc., [15]. There are many standards on these and these are summarized in NBC of India [5]. These standards describe in detail about ventilation & lighting requirements, designing for various soil conditions, earthquakes, wind, snow, gravity and other incidental loadings, building materials, thermal comforts, circulations, room sizes, etc., in various geo-climatic conditions and building uses. The earthquake standards are covered in standards like IS 1893, IS 4326, IS 13920, IS 875, etc., and fire prevention is dealt with in NBC under fire safety of buildings chapter [6,9,16,17,18]. The earthquake codes have given detailed guidance about the probability of occurrence of earthquakes, its expected ground acceleration, damping of various types of buildings, estimation of earthquake forces on various parts of buildings and designing of various types of buildings[6,9,16]. Regarding fires, detailed discussions are included in NBC about specifications and current/heating capacity of wires/cables/switches, insulations to cables/wires, MCB,MCCB, RCB, earthing, fire doors, fire alarms, smoke detectors, fire sprinklers, etc., and underground/overhead tanks and fire exits at every 22.5 meters, fire terraces, spaces around buildings (setbacks) for movement of fire tankers, etc., [5,18].

There are detailed guidelines in the National Building Code of India (NBC) 2016 and bye-laws of various cities to plan, design, construct, and maintain different types of buildings as per their uses or business, footfall, and importance, for Loading, Earthquakes, Cyclone, Fire, Ventilation, PHE, Electrical, etc., [5,7,8]. It is expected that concerned local statutory authorities ensure these provisions, but a quick reconnaissance survey reveals its massive violations in almost all cities in India by specialized agencies like NDMA/NIDM/BMTPC/CPWD [19,20,21,22]. After every disaster, only owners & contractors are held responsible and bigger operators like responsible officials, police, politician and middlemen are spared to operate again with impunity. Now, when we talk about sustainability and differently able people-friendly buildings in India, are we not making fun of ourselves, with our current situation of built environment?

There are several states in India, that have formulated their building bye-laws, dealing with planning & designing of various types of buildings and these are generally in line with NBC of India, but they are also having influence of local climate, geology, climate, construction materials and typology in these standards [23]. Buildings bye-laws are legal documents and each building must follow these. Some Indian State’s building bye-laws has more stringent provisions than NBC, like the limiting height of construction and recommending framed construction even in low-rise construction up to 3-4 storeyed constructions, whereas NBC allow load-bearing construction up to 3 (three) floors in seismic zones V and 4 (four) floors in seismic zone II to IV for residential buildings[ 5,8].

Although local building bye-laws are legal cum technical documents, their implementation on the field is an issue, as most of the buildings are not planned, designed, constructed, maintained, and used as per its provisions. There is no effective and credible mechanism to ensure the implementation of bye-laws and quality standards. Frequent alteration and modification in well-designed and constructed buildings have made them vulnerable [1,3,4]. Hence, it is a matter of grave concern.

Public agencies of central and state government are responsible for public housing & public buildings and they follow all the provisions of NBC & local building byelaws in planning, designing & constructing buildings, but many a time its user makes lots of unauthorized structural changes, which makes these buildings prone to both earthquakes & fires [21,22]. Many a times, many non-structural changes made in buildings do affect the strength and stability of the structures particularly from seismic point of view.

Past experiences from earthquakes like Latur, Jabalpur, Kutch, Uttarkashi, etc., have again and again proved that failure of many privately built buildings is the main cause of loss of life and predominantly these are non-engineered or poorly constructed/supervised buildings, which had collapsed in these earthquakes and had killed thousands of people, compared to very little loss to public buildings [1,3,4,21,22]. The role of a few Geo-technical investigating agencies is also doubtful as many a time fudged soil investigation reports are submitted. In the Kutch earthquake, roles of a few builders, architects, geotechnical professionals, structural engineers and statutory authorities were also doubtful as many buildings were constructed without any application of NBC/Building bye laws and its structural configurations were very weird, resulting in collapses of buildings as far as 300 km away from epicentre of the earthquake [1].

It was generally observed in all these disasters, that public buildings fared much better than private buildings, as in public buildings all provisions of NBC/Local Building Bye Laws have been followed in planning, designing and construction [1,21,22]. Jabalpur earthquake was an urban earthquake, which shook India, as generally all major previous earthquakes struck in rural/low economic activities areas, where except Latur/Kutch, loss was also low [1]. Jabalpur earthquake also proved that public buildings are safer than privately constructed ones. In Sikkim, (Earthquake 2011), private and public both buildings both were affected as being hilly areas, earthquake also induced landslide, which affected the whole of terrain, in such cases, land use must be properly analysed, by doing slope analysis [3,4,5]. The nation has also started a micro-zonation study, where soil stratification is studied at some scale and reports are published so that any local geotechnical reports can be matched with that area’s micro-zonation study for better understanding of local soil report [1,21,22].

There is a well-defined set of guidelines in National Building Code of India (NBC) 2016 to conduct periodic safety audits of all buildings, every 3 to 5 years as stated clearly in Chapter II in the administration part of this code [5]. These multi-disciplinary audits will expose the vulnerability of existing buildings in terms of Fire Safety, Structural Safety and disable friendliness as well as of electrical Installations, etc. These post-construction audits will also be useful to know, how unsafe the buildings are, vis a vis the revised latest norms laid down in National Buildings Code 2016, for buildings constructed based on older NBC [5,15]. The authorities have completely ignored these provisions and may cite reasons for inadequate technical manpower with them as a possible cause for these violations. In such a case, NBC clearly recommends that technically qualified professionals from the market/field may be engaged to carry out the desired task and recommend strengthening/retrofitting measures [5]. Only after the same is incorporated, the buildings should be allowed to be operated for the approved building use. These audits will ensure compliance with building Bye-laws and also the specific approved building use of the buildings whether commercial, institutional, industrial, public, semi public, or residential, etc. Design of Hospitals are now also governed by NDMA hospital safety guidelines, which extensively cover all design provisions for new and existing hospital buildings for Loading, Earthquakes, Cyclones, Fire, Ventilation, PHE, Electrical, etc., [19].

1. **Case Study:**

A few cases of fires and failures/collapses of buildings in residential areas, planned, designed & constructed by public authorities in NCR (National Capital Region) of Delhi, the capital of India, have been studied, as reported by national media (national newspapers). There are several cases of fires and building collapses in Delhi, but only a few cases of recent time, have been studied, otherwise such list is very long, given the population and numbers of buildings in India [12].

In Delhi, there are many fire incidences in almost all types of buildings, as in a hotel at Karol Bagh, fire broke out where all escape routes were found to be blocked. There was no fire alarm/extinguishing system and several guests have injured/died. It was later found that this building was operating illegally and has done lots of illegal modifications and alterations [1,3,4]. In many busy markets (Old Delhi, Sarojini Nagar, Lajpat Nagar, Laxmi Nagar, etc.), fire broke out many times and stuff worth millions of rupees got perished [1,3,4]. In such cases, it was found that these shops have extended their floor areas and electrical cables were not of proper configuration (in terms of current carrying capacity and fixity of connections). In Delhi/Mumbai, fire in hospitals is also becoming common, where lots of critically sick patients have died as they could not be evacuated due to faulty building designs and encroachment in escape routes [1,3,4]. Fires in cinema halls is also common nowadays, like Uphaar Cinema Hall in Delhi, where several people perished due to fire related mismanagement, as their exit doors were locked from outsides (during live movie show) and there were lots of inflammable stuff in its basement [ 1,3,4].

It is found (2024) in case of a fire in a low-rise residential building in Dwarka, Delhi, that one lady has died and another is injured as they jumped from the fourth floor to escape fire, as reported in The Hindustan Times newspaper [26]. The cause of the fire was suspected gas leak/short circuit. The firefighting system was installed in this building, but was found to be out of order at the time of this incidence. This was well designed, constructed and approved building in Delhi, but fire fighting systems was not in working condition. In another case of fire, firemen miraculously escaped while dousing fire, after four storied building caught fire in west Delhi and the whole building had collapsed in fire [27]. In this case, this was a low-rise residential building, where evacuation from second floor was done through the external ladder (since there was no other escape route). Here, fire fighting system was not existent and external ladder was provided by Fire brigade. A coaching centre in Delhi, caught fire and its fire escapes routes were found to be blocked, students had to jump from their classrooms to save their lives. There was no fire detection or fire extinguishers were installed in this building, and this building was highly crowded [28].

There are numerous cases of fires in authorized as well as in unauthorized buildings due to many reasons and it is observed that causes of fires as well as causes of casualties and causes of loss is also same i.e. absence of fire warning and extinguishing system and blocking of escape routes. Many a times population prescribed in these buildings was not adhered to and manifold people were accommodated in these buildings having narrow escape routes in congested lanes.

Regarding building collapse, few residential buildings designed by public agencies have been studied and found that since there is no major earthquake in Delhi in recent times, hence, such collapses have not been observed. A prominent national level newspaper, “Times of India”, has reported that lots of DDA flats (Flats built by public agency in Delhi, Delhi Development Authority) have been modified by doing illegal constructions, hence these may not survive earthquakes and fires [29]. It is a well known fact that there is a widespread unauthorized modification have been done in flats designed by public authorities in Delhi, like DDA, MCD, CPWD, NDMC, NBCC, etc. DDA has shown a list of illegal construction in DDA flats on its website [30], but a decisive action is missing on the ground to either retrofit them or demolish them. The issue is that urban spaces are limited and everybody wants more spaces, for which they extend their flats/house horizontally and /or vertically by disturbing its structural systems (columns, beams & slabs). The connections between extended construction and old constructions are generally not strong enough to take care of extra loads, especially seismic loads and there is a chance of collapses of the whole of the structure (floors above and floors below). We are witnessing lots of such cases of collapses of buildings, where even during such executions, buildings are collapsing.

Even the hon’ble High court of Delhi has commented on the sad state of affairs of monitoring of construction and operations of buildings by saying that “Illegal construction on a scale previously unheard of” [31]. This is happening because of rampant illegal construction and encroachment of public spaces. Further, the Hon‘ble Supreme court of India, also observed that more than 25% of Delhi has to be demolished, if all illegal construction to be demolished [32]. The Hon’ble Court also questioned the government for protecting such illegal construction, as government, under public pressure wanted to regularise illegal construction.

Few such collapses in residential buildings built by private persons have also been studied, which happened even without earthquakes in Delhi NCR region. A five-storey under-construction residential building in Lalita Park, Delhi, collapsed in year 2010, which was being built illegally, was close to Yamuna River, killing about 67 (sixty seven) people and injuring about 73 (seventy three) people [33, 34]. Here, it was found that, this building was not well designed & supervised by unscrupulous people and has not been approved by authorities hence, there was gross negligence from the monitoring staff of the concerned authorities, that such buildings are being constructed. A multi storied building, designed and promoted by NBCC Greens at Gurgaon [35], built by contractors was so poor that it has been declared structurally unsafe within three (3 or so) years of construction. The multi-storeyed residential complex, Signature view at Mukherjee Nagar, Delhi [36] developed by DDA is about 15 years old, but is in very dilapidated conditions due to quality issues. Hence, when design is all right, but quality of construction is very poor, the building becomes unsafe. These are unique cases, where buildings designed by a public agency have been declared unsafe much before end of its service life, due to bad quality of construction by its contractors. Chintel Paradiso, [37] this privately constructed but approved by government high-rise residential buildings in Gurgaon, NCR Delhi region, showed sign of distress and in one of its towers, an RCC roof collapsed and killed two (2) people below, again due to technical and construction issues. The illegally built residential buildings at Shahberi village at Greater Noida, NCR region [38] have tilted on each other and collapsed in the year 2018, these buildings were constructed without any approval, have collapsed killing nine (9) people. A high-rise twin towers, Apex & Ceyane built by a prominent builder, Supertech in Noida, NCR region of Delhi, was built illegally [39] flouting all the bye laws. These high-rise illegally constructed buildings were finally demolished by Noida authority under instruction from the Hon’ble Court for violation in building Bye laws.

There are many such cases, but for the sake of reporting, only media-highlighted few cases have been taken, as naming other cases may lead to techno-legal complications. However, in all such cases, it appears that these all buildings were either not designed & constructed properly as per Indian standards/guidelines or have not been maintained properly either due to illegal construction or encroachment or ignorance.

1. **Results and Discussions:**

It can be concluded that the majority of the buildings in Delhi are non-engineered, vulnerable and prone to both earthquakes & fires due to inherent structural weakness & community negligence. Majority of the buildings are non-engineered built by unscrupulous people in connivance with land owing agencies responsible for safe construction. In these buildings, no geotechnical investigation, site analysis, building design or quality testing is done. Even the buildings designed and built by public authorities following all standards & guidelines for safe construction, have been turned vulnerable by non-engineered structural changes and low-quality fire services. This is also happening at a large-scale all-over India. Monitoring of construction of buildings is very weak and in fact it appears that authorities are hand in glove with these illegal construction gangs and public pressure is so high, that government also do not directly interfere in this. In case of any mishap only contractors/civil/structural engineers are made scapegoat.

Many buildings had collapsed and several enquiries have been conducted and it was found in almost all of these cases concerned authorities were not monitoring construction/operation of these buildings and many of them were being constructed at a very fast pace to avoid any detection/ action by any authorities, further increasing chances of their collapse, as required strength of the structural members do not develop in short time in RCC (Reinforced Cement Concrete) construction, which is required for continuing construction thus buildings collapsing due to its own weight or failure of the foundations/shuttering in many of the cases.

Since, these were all unauthorized construction, there is was fire safety provisions. Cables/wires provided were of under capacity, electrical panels, earthing, MCBs, MCCBs, RCBs, have not been provided or were not in working condition. Basements have been used to store inflammable materials, exit routes were either closed or were accessible. Lanes/streets leading to these buildings were narrow and further encroached upon either by construction or parking, so fire tenders cannot reach to these buildings.

The government and the public authorities need to check this menace urgently to saves lives and properties. Migration of people to urban areas in very high and everyone wants a house in the urban localities, without even caring for its quality of construction and vulnerability to hazards like earthquakes & fires. The government is also sometimes adopting a lenient approach towards illegal and unauthorized constructions. Hence, it encourages and promotes such malpractices leading to higher vulnerabilities. However, courts in India are taking strict action and have ordered demolitions, sealing & imposing heavy fine on such buildings, in recent past.

1. **Conclusion:**

Local development authorities must gear up to ensure the recommendations of NBC, local building bye-laws and guidelines of NDMA are followed in letter & sprit on ground. The technical audits, as recommended in bye-law (when local building Bye-laws incorporate NBC, NBC becomes a Law), must be carried out every 3 to 5 years, and measures to enhance safety must be taken. The authors strongly feel that, these steps will bring tremendous improvement in safety levels in the entire built environment. Professional bodies like the Indian Association of Structural Engineers (IAStructE), Bureau of Indian Standards (BIS), Institution of Engineers (India)(IEI), CEAI (Consulting Engineering Association of India), IIA (Indian Institute of Architects), COA (Council of Architecture), etc., may also be roped in for professional inputs, wherever required. This exercise needs to be diligently carried out in every city of India. India, being the fastest growing economy and having urbanization level of more than 30%, needs to address these issues on top priority, as India cannot afford to put its people in death traps. It is high time to wake up and act, especially aftermath of the Türkiye earthquake. India, has to increase monitoring and stop all illegal/unauthorized construction, especially construction in Lal Doras, and practice of additions/alterations/modifications in DDA/Government Planned buildings, as this is a very common practice in almost all the cities, which not only weaken those buildings, but also neighbouring buildings in case of occurrence of earthquakes and/or fires.

If a person pays to get coaching, the responsibility of his/her safety is to be ensured by the person taking money and providing coaching. They are expected to see conformity of these buildings as per building use/safety defined in NBC. But such coaching institutes claim to be either innocent or victim, as the building for coaching is not owned by them but is either hired or built & maintained by someone else. The conformity and structural safety of such buildings is not known to them. If they ask for such certificates, they will not find any place in any urban centres to operate, as most of the buildings are defying approved building use, Loading, Fire, EQ, Cyclone, Electrical systems. The buildings do not have a proper escape route. If escape routes are there, they are often locked up or encroached upon. The basements in the buildings are being used to run cafeterias or storing inflammable goods, which is further adding woes. Even streets/footpaths are encroached upon and Fire Tenders cannot move in case of emergency. The availability & capacity of Fire tenders in cities is also doubtful as have been seen in most of the cases mentioned above that fire tenders reached late and do not have ladder of sufficient heights. However, whatever may be the case, the building should fulfil all the safety requirements for its appropriate usage, as envisaged in NBC 2016 or local building bye-laws.

There is another dimension that is further complicating this issue, which, even best planned, designed & constructed buildings are violating approved building use and many a times staircases are locked, giving the impression that the civil society is not well aware and/or does not care for safety. Corresponding author recently visited the CBSE (Central Board of Secondary Education) office in Patparganj Area, Delhi and found that this building in fact has taken a few clues from NBC and displayed allowed loads on every floor of this building. However, such practices, are rarely followed in most urban localities.

The biggest question is, where public should go as a consumer, for shopping, education, recreation, dining, offices, and medical treatment? Most of the buildings, pavements, lanes/roads are unsafe. People construct floors on top of shops/houses and cut beams/columns to extend balconies horizontally, even in posh DDA/planned colonies (by government bodies like Development Authorities, Housing Boards, etc.,) without any fear, then what can be said about peripheral urban villages in proximity with the cities, as they get few privileges/immunities being in village area (Lal Dora area). There is no one to listen/act on such issues as all those who violate the building bye-laws seem to be hands in gloves with each other, but in case of any earthquake, these so-called modified engineered buildings will behave like non-engineered buildings as their vital structural columns, beams & slabs have been cut. The public authorities must take adequate timely steps to stop such types of greed-based modifications/extensions that threaten human lives. The concerned enforcement authorities should act on such large-scale violations to reduce the vulnerabilities and risks from disasters like earthquakes and fires. In recent times, other types of human related disaster like terrorism have also affected the society, where the public has been targeted with explosives in the markets or public places that affect buildings & services also.

The study revealed that although India has sufficient technical expertise in planning, designing, construction, maintenance and management of buildings, but its building stock is still highly vulnerable to many hazards, especially earthquakes & fires. There have been many incidences of such cases in recent past, but no concrete steps have been taken in these directions, hence there is a dire need to learn lessons from such events and pave way forward for disaster resilient buildings & infrastructure, to reduce human casualties, property losses as well as environmental losses.

1. **Conflict of Interest:**

We all the authors, certify that we do not have any conflict of interest in carrying out this study. It is also certified that we have not taken any grant/financial assistance to carry out this work.

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