

**THE ROLES OF REAL ESTATE DEVELOPER
COMPANIES IN DISASTER MANAGEMENT IN
DHAKA CITY**



Inspiring Excellence

A Dissertation for the Degree of Master in Disaster Management

By

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LIST OF ABBREVIATIONS

AMT	Arakan Mega Thrust
BFSCDA	Bangladesh Fire Service and Civil Defense Authority
BNB	Bangladesh National Building Code
CDMP-I	Comprehensive Disaster Management Programme-I
CTFB	Chittagong-Tripura Fold Belt
DAP	Detailed Area Plan
DCC	Dhaka City Corporation
DF	Dauki Fault
DMA	Dhaka Metropolitan Area
DMB	Disaster Management Bureau
DMDP	Dhaka Metropolitan Development Plan
DRR	Disaster Risk Reduction
DWASA	Dhaka Water and Sewage Authority
E.V.I.	Earthquake Vulnerability Index
FAP-	lood Action Plan
FAR	Floor Area Ratio
HSD	Housing and Settlement Directorate
MFTF	Main Frontal Thrust Fault
NHA	National Housing Authority
NTF	Naga Thrust Fault
PLD	Private Land Development Companies
PWD	The Public Works Department
RAJUK	RajdhaniUnnayanKartripakkha
REHAB	Real Estate & Housing Association of Bangladesh
SDGII	The Sustainable Development Goal II
TI Act 1953	Town Improvement Act 1953
UDD	The Urban Development Directorate
WASA	Water and Sewage Authority

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ABSTRACT

Dhaka, the capital city of Bangladesh, is one of the populous megacities in the world. As the growth of urban population is taking at an exceptionally rapid rate, the landscape of the city is forced for rapid urbanization to keep pace with rapid increase in population. Rapid and haphazard urbanization is creating a lot of environmental and physical hazards. Dhaka is already exposed to natural hazards such as flood and earthquake, but interventions of some government agencies such as RAJUK and private housing companies are damaging the environment in many ways. Apartment building construction introduced by private Real Estate Developer companies have not only contributed in the national economy but at the same time due to lack of sustainable issues in their building policy, Dhaka is now under threat to many man made hazards. Through this research it is evident that these developer companies are more focused towards making profits rather than achieving sustainability. The residents of the apartment buildings have shown much concern for their safety in their building as well as in the neighborhood for which many suggestions and problems have been brought forward by them which they prefer should be addressed by the developer companies in near future for sustainable and healthy growth of Dhaka city. Some suggestions on Bangladesh National Building Code has been addressed for achieving sustainability and disaster management for Dhaka city.

Chapter 1

Introduction

1.1 BACKGROUND

Bangladesh is a low-lying deltaic country situated in between 20°34' and 26°38' latitude and between 88°01' and 92°41' east longitude and formed by the Ganges, the Brahmaputra and the Meghna rivers. Urbanization worldwide has been found to be an effective engine of economic growth and socio-cultural development. Urbanization in the context of Bangladesh marks a long history possibly of over 2000 years. Dhaka being the capital and the only megacity of Bangladesh has experienced rapid uncontrolled urbanization. The evolution of Dhaka into a megacity has created many serious problems for the city and its surrounding regions. One of the fastest growing cities of the world, Dhaka, is facing problems of traffic jam, solid waste disposal, water logging, housing, water, air and noise pollution, ground water depletion, lack of utility services, loss of wetlands, etc. due to exceptional population growth. Due to rapid increase in population, Dhaka city has faced tremendous shortage of housing and necessary infrastructures. Due to shortage of buildable land and unaffordable land price the inhabitants are forced to purchase apartment units in mid or high-rise buildings. But the buildings constructed in Dhaka city by the individual land owners or by the Real Estate Developer companies did not follow the characteristics of sustainability resulting significant threats to wellbeing. Uncontrolled and unplanned urbanization has also made Dhaka city vulnerable to many natural hazards such as earthquake, flood, and also fire incidents are increasing at greater rate. As a result it has become a necessity to understand the current situation of the housing sector in Dhaka city in terms of sustainability and disaster management. As the private Real Estate Developer companies play a vital role in providing thousands of residential apartment units in every year, therefore, the focus of this research will be on the roles of Real Estate Developer companies in disaster management in Dhaka city. The current practice trend in apartment building design by the developer companies will be analyzed to find out the problems faced by the apartment dwellers so that these

issues can be addressed in near future for more suitable and sustainable built-forms in Dhaka city. Also the national building code will be analyzed. The safety of the city dwellers should be the prime concern of the government and concerned stakeholders. One of the important issues of living in an apartment building is the safety issue which needs to be addressed in order to find out how well aware are the apartment dwellers and developer companies about fire, earthquake, and other associated hazards and their way of managing these disasters or reducing the risks of such threats.

1.2 PROBLEM STATEMENT

Dhaka is a very fast growing megacity. It is estimated that the total urban population will be 60 to 80 million, which is one and a half to nearly 2 times of the current urban population, by 2020. The main two reasons for the rapid growth of population in Dhaka city is firstly due to the natural growth of the city and secondly due to huge number of people (both rural and other urban areas) migrating into Dhaka city in order to make their lives better with greater opportunities and to enjoy the modern and civic facilities.

In order to accommodate the present and the future population Dhaka city in undergoing huge and rapid urbanization which are creating opportunities as well as challenges/ problems for the citizens. The haphazard urbanization or the unplanned growth of housing sector has given rise to many problems such as loss of wetlands, lack of open space, traffic congestion, pressure on utility services and community facilities, land speculation, loss of habitat of fauna-flora and biodiversity, loss of productive agricultural land, lack of air and sunlight, noise and air pollution, fire hazards, slum and substandard housing condition.

The demand of housing in Dhaka city is dramatically increasing due to increasing population growth and its fast growth rate. At least 100,000 new housing units are required in every year. It is found that 30% of total population of Dhaka city has already covered 80% of residential areas with human settlement and supportive infrastructures. The housing deficit in urban areas grew from 1.13million units in 2001 to 4.6million units in 2010 and it is predicted that the deficit will reach to 8.5 million units in 2021 if the investment does not keep pace with the growth of population. There is an extensive need for the rapid increase in housing units which are partially

being provided by Real Estate Developer companies besides government agencies.

1.2.1 LACK OF SUSTAINABLE BUILDINGS BUILT BY REAL ESTATE DEVELOPERS

Real Estate Developer companies play an important role in providing accommodation by constructing mid-rise to high-rise apartment blocks with necessary services and infrastructure facilities. The large unsatisfied middle-income class is expected to be boosting market for the real estate business as middle and upper middle class people have started to show more interest in buying apartments due to increased and unaffordable house rent. The factors for the development of apartments:

- a. Desire to live within the city
- b. Increasing commercial market for apartments
- c. Profitable for both owners of land and developers
- d. Availability of loans from financial institutions
- e. Existence of flexible rules for development
- f. Reliable developers in the real estate
- g. Ownership of a few apartments and ready cash

High-rise buildings are becoming a common phenomena in Dhaka city to accommodate this huge population in comparatively small amount of space. Though high-rise apartments seem to be a good solution to tackle the housing problem in Dhaka city, it has been found to generate new challenges or problems which are:

- a. Puts pressure on utility services like water supply, gas and electricity.
- b. Increases traffic congestion and parking problems
- c. Creates problems of light and ventilation for adjacent small buildings.
- d. Fire fighting problem
- e. Problems related to inadequate number of lifts
- f. Inadequate parking space
- g. Lack of community space
- h. Lack of children play area
- i. Socio-psychological problem

1.2.2 LACK OF PARTICIPATION OF REAL ESTATE DEVELOPERS IN DISASTER MANAGEMENT

Along with the micro level problems associated with individual buildings constructed

by these companies, city level damage is also caused by them. The Real Estate Developer companies and RAJUK violated the Structure Plan by filling up the wetland of Dhaka city. Due to high corruption and weak monitoring, RAJUK failed to control the violation of building construction rules which resulted in congested and unhealthy city.

One evident source of law violation can be found in land use change which is very prominent in Dhaka city. Land use change such as commercialization of residential areas is dreadfully affecting the habitable environment of the city. The defiance to follow land use plan creates traffic congestion, inadequate provision of utility services, air pollution, noise pollution, overcrowding, lack of privacy, insufficient parking facility, lack of accessibility, frequent water logging and affects the cost of providing public infrastructures and services such as roads, schools, water and sewage, garbage collection, transport, and mail delivery. On macro level land use change can have adverse effects on Dhaka city.

Dhaka is a high-risk zone considering its high population density, poor physical structure, poor economic condition and least response and recovery capabilities. The threats for Dhaka city are found in:

- a. Vulnerability to flooding due to indiscriminate filling of water retention and flood flow areas.
- b. Presence of vulnerable and dilapidated buildings.
- c. Over dependency on ground water
- d. Fire hazards of the interlocked construction is high and the problem is multiplied by poor access.
- e. Filling and encroachment of flood plains and water bodies.

Dhaka is highly vulnerable to natural hazards such as floods, heat waves, earthquakes, fire, drainage congestion/ water logging, infrastructure collapse, ground water depletion, epidemic and surface water, air and sound pollution.

Floods of 1988 and 1998 were catastrophic. Poor drainage has been identified as the principal cause of flooding in Dhaka Metropolitan Area. Flooding in Dhaka is mainly caused due to heavy rainfall, drainage congestion, high surrounding water and overflow of rivers. The experience of the 1998 flood suggests that the city needs to be saved through structural and non-structural measures for flood mitigation. Eastern periphery including one in the north and those outside the embankment at the western

periphery of the city suffered severe flood damage. Central wards along north-south strip were safe. Under a changing climate, extreme floods may increase, aggravating the situation for the citizens of Dhaka city. The disaster management of Dhaka city shows weakness in enforcement of protection policies for flood plains, hazard prone and low-lying areas, failure to execute building control regulations.

Rapid population growth and unplanned development, uncontrolled land filling to develop new residential areas, uncontrolled and haphazard disposals of solid wastes and garbage into the existing drainage system, and encroachment on lakes, canals and rivers with unauthorized construction are the general man made physical and social activities related to the disappearance of natural drainage system resulting in the water logging in Dhaka city.

Encroachment on ecologically sensitive areas through unplanned housing built by individual landowners as well as private developers, along with the discharge of waste water and solid waste into water bodies is responsible for the degradation of the landscape and associated loss of biodiversity. Many ponds that worked as runoff reservoir and met the domestic water needs besides being used as community space are filled up to create space for housing and roads. The surface water quality of canals, rivers, ponds and marshy lands has deteriorated in Dhaka due to untreated disposal of sanitary sewage and solid waste.

48% of the total land area is urbanized which cannot percolate water into ground water, as a result the ground water is depleting at an alarming rate. DWASA mainly depend on ground water extraction, and in recent years due to over extraction and reduced percolation, water table in Dhaka has currently dropped to below 1200', which was about 10' to 20'.

The presence of major seismic sources around Dhaka city and rapid urbanization of Dhaka with unplanned high rise and multistoried buildings in congested communities, exposed and risky electric lines definitely pose a serious threat to the people with regard to earthquake disaster. High earthquake risk has surfaced in the newly developing low-lying areas due to land filling which may cause severe liquefaction during earthquake.

Scarcity of readily available water sources and open spaces in neighbourhood can accelerate the fire hazards in Dhaka city.

With urbanization comes marginalization of the poor, who are compelled to the rather hazardous, unsafe areas of the cities and possibly to locations where construction may have been forbidden formerly. Due to rapid growth in population and unplanned urbanization, living conditions in Dhaka has deteriorated and the access to services is not socially just.

Lack of coordination among planning organizations at different tiers of government is a specific problem area of strategic urban management in Dhaka. Faulty planning, lack of coordination among various agencies and an overall disregard to environmental issues, also prevents Dhaka city from having a healthy growth. Almost all the alarming conditions in Dhaka city are due to the built-up areas. Thus, it has become crucial to manage the built-up areas in a way that the future of Dhaka city can sustain.

The problems associated with the housing sector especially the multi storey residential buildings provided by the Real Estate Developer companies lacks sustainability issues and disaster sensitive design approach.

1.3 OBJECTIVE OF THE STUDY

To find out the roles of Real Estate Developer companies focusing on sustainability and disaster management issues in residential apartment buildings of Dhaka city.

1.4 METHODOLOGY

Questionnaire survey is conducted in the form of an interview. As close-ended questions probably limit the responses to the topics thus, both closed and open-ended questions were designed to gain maximum possible results. Secondary data collected from publications such as books, journals, internet, reports, etc. Field survey is conducted for further data collection and verification of given data.

1.5 DATA ANALYSIS

MS Office Excel 2013 is used to analyze the data.

1.6 LIMITATIONS OF THE STUDY

Due to lack of time, resources and money the study is focused on specific criteria. For this, extensive research could not be made possible which otherwise could have added more value to it.

Chapter 2

Literature Review

2.1 URBAN SCENARIO OF DHAKA CITY

2.1.1 OVERVIEW ON URBANIZATION IN DHAKA CITY

Bangladesh was a predominantly rural society with only 10% of total population living in urban areas from 1950s to mid-1970s. In Bangladesh (at only 28% urban), this sector currently contributes to more than 65% of the national GDP (Forests, 2016). The censuses 1901-1974 treated all places within municipality or town committee or cantonment areas as urban and from 1981 onward development centers and Thana Headquarters have also been considered as urban (Khan, 2012). Bangladesh has some 570 urban centers of which Dhaka is a megacity which spreads over 4 other districts covering an area of over 1400 sq.km with a population of 14.7 million. (Forests, 2016). 25 urban centers are cities with population of over 100,000 each and the rest are small towns, 11 City Corporations and over 322 Municipalities administered under local government (Forests, 2016).

The rapid urbanization growth reached 11% per year during the period 1975-80 (GED, 2015). From 1980-2010 the urban growth has averaged 4.4% per year (GED, 2015). In Bangladesh 28% of total population live in cities (43 million), of which one-third reside in Dhaka alone (Biswas et al. 2012). Population of Dhaka is 5 times more than its capacity (ideally 30 lakhs) (Biswas et al. 2012). The annual population growth rate of Dhaka city is projected to be 3.82% between the years 2014-2030 (Ahsan, 2016). In Dhaka the rural-urban migration rate is 4.2% which is one of the highest in the world (Bahauddin et al. 2014). The population density is 20000-135000 persons per sq.km and the average occupancy per dwelling unit is 7.5 persons (Ahamad & Hasan, 2010). About 40% of the city dwellers are said to be poor, 50% is of middle income and the remaining 10% are of higher income group (Ahamad & Hasan, 2010). 75% of land is below natural water level and 95% within 5-7m flood level, 62% residential area and 8% commercial area (Hasnat & Hoque, 2016).The

population of Dhaka is 1.5 crore and it ranks 20th out of 27 most populated megacities in the world (Biswas et al. 2012). In the last two decades the development trend of Dhaka city is taking place in both vertical and horizontal direction in order to cope with overpopulation, scarcity of land and spiraling land prices (Islam & Adri, 2008, Khan, 2012), but by violating building rules and regulations in most cases (Nahrin, 2008). In the last 12 years (except 2000, 2001, 2005, 2006, 2011) the highest temperature recorded was more than 40°C and in 2012 rainfall was 137mm in Dhaka city which is normally 339mm (Biswas et al. 2012). The way the urbanization is taking place in Dhaka city, soon the whole city will turn into a heat island making it unfit for human habitation (Biswas et al. 2012).

Due to rapid growth in population and unplanned urbanization, living conditions in Dhaka has deteriorated (Biswas et al. 2012) and the access to services is not socially just (Rahman M. A., 2015). People in Dhaka are suffering from heat stroke, diarrhea, typhoid, cough, cold fever (Biswas et al. 2012). At present there are 6.68% roads of total land area in Dhaka Metropolitan Area (DMA) including 52% inaccessible road for motorized vehicles (Hasnat & Hoque, 2016). The surface water area (rivers, lakes and canals) of Dhaka city is about 10%-15% of total land area (Islam et al. 2010 and Biswas et al. 2012). Dhaka city creates huge vulnerability indices by concentrating more population, buildings, infrastructure and economic activities in an unplanned way (RAJUK R. U., 2015). The city's groundwater level has dropped about 20m over the last seven years (RAJUK R. U., 2015). The buildings in Dhaka city which are old and dilapidated, newly built but faulty design and overloaded weak buildings are highly at risk of being collapsed, and in a recent survey it is found that 78000 out of 326000 buildings are detected as risky (RAJUK R. U., 2015). Every year, at least 100,000 new housing units are required in Dhaka city (Ahsan, 2016). The community life of Dhaka city is under huge threat due to sharp violation of land use plan (Nahrin, 2008). The rainwater cannot be absorbed due to the unplanned construction of roads and housing development (Ahsan, 2016). About 40% to 50% of daily solid waste is collected and disposed by Dhaka City Corporation (DCC) and the rest is disposed of illegally by residents into the vacant lands, low lands, street, canals and drains (Ahsan, 2016). The surface water is being polluted by domestic and industrial sewage disposal without treatment directly into water bodies (Seraj & Badruzzaman, 1997). The Real Estate Developer companies and RAJUK violated the Structure Plan by

filling up the wetland of Dhaka city over the past 10 years (Mahmud, 2007). If the water bodies are filled up at this present rate then there will be no water bodies after 2035 and the temperature of Dhaka city will increase by the reduction of water bodies (Biswas et al. 2012). Therefore, the present condition of Dhaka city is very alarming capable of giving rise to many hazards, which if not taken necessary precautions will create huge disasters in the coming years. Almost all the alarming conditions in Dhaka city are due to the built-up areas. Thus, it has become crucial to manage the built-up areas in a way that the future of Dhaka city can sustain.

2.1.2 EFFECTS OF RAPID URBANIZATION IN DHAKA CITY

Dhaka is the most polluted city in the world with 30 types of pollution mainly water, air, sound and dust (Biswas et al. 2012). High earthquake risk has surfaced in the newly developing low-lying areas due to land filling which may cause severe liquefaction during earthquake (Ferdous & Rahman, 2015). Immense land use and transport problems are occurring due to rapid scattered and unplanned development (73% fully unplanned) (Hasnat & Hoque, 2016). By filling up the wetlands, the drainage system of Dhaka city becomes ineffective and causes water logging situation (Islam et al. 2010). Every year severe water logging causes huge loss in social, physical, economic and environmental during monsoon season (Islam et al. 2010). The risk of flooding is also growing due to rapid urbanization and concurrent encroachment on retention areas by land grabbers, as a result the drainage system fails to drain out the water during heavy and unpredictable rainfall (Thiele-Eich et al. 2015 and Yahya et al. 2010). Health risks such as gastrointestinal disease, increase in vector borne disease, psychological effects and possibly death are increased by flooding (Thiele-Eich et al. 2015). Scarcity of readily available water sources and open spaces in neighbourhood can accelerate the fire hazards in Dhaka city (RAJUK R. U., 2015). 48% of the total land area is urbanized which cannot percolate water into ground water, as a result the ground water is depleting at an alarming rate (RAJUK R. U., 2015). Loss of biodiversity has become a matter of concern (Ahsan, 2016). Improper solid waste management causes environmental pollution such as bad odour, degradation in air and soil quality, surface and ground water pollution, the creation of microbial breeding grounds and the inducement and land aggravation of health hazards (Ahsan, 2016). Dhaka is prone to environmental disasters due to high population, expansion, urbanization and financial growth (Biswas et al. 2012). It is

found in a study carried out in Gulshan that the service facilities such as drainage, sewerage, gas, electricity might become inadequate if rapid development of apartment buildings and the eventual increase in density persist (Nabi et al. 2004).

2.1.3 CONTRIBUTING FACTORS FOR RAPID URBANIZATION

The natural growth of Dhaka city and the rural to urban migration led to the rapid urbanization (Khan, 2012). The natural growth of Dhaka city in terms of native urban population and extension of native urban areas by the conversion of rural centers to urban (Forests, 2016). Besides its natural growth, Dhaka has to accommodate 40% of the rural to urban migrants in every year (Mahmud, 2007). Dhaka has a population of 11.2 million and it is the most urbanised district at 93% (Forests, 2016). Not only the rural people are migrating to Dhaka city to find jobs but also the wealthy people from all around Bangladesh are also moving into Dhaka in order to make their lives better with greater opportunities and to enjoy the modern and civic facilities (Ahamad M.). It is found that nearly 100% (i.e. 100000 people in total) of the heads of the household of the largest slum in Korail area of Dhaka city has migrated into the city (Forests, 2016). It is expected that Dhaka will become one of the 10 largest cities of the world by 2020 with a population of about 20million (Ahamad M.). About 25% of total population of Bangladesh is residing in urban areas, 34% will be living by the year 2015 (Barua et al. 2010 and Ahamad M.) and 50% will be living by 2025 and Dhaka will be populated by 27.4 million (Ahsan, 2016). It is estimated that the total urban population will be 60 to 80 million, which is one and a half to nearly 2 times of the current urban population, by 2020 (GED, 2015). From 1961 to 2011 the total urban population increased from 2.6million to about 43.43 million (i.e.1600%), whereas, the total population of the country increased from 55million to 150million (i.e. 273%) (GED, 2015). 60% of the total urban population live in City Corporation areas and the remaining population in Pouroshova areas and small towns (GED, 2015). During the period from 1981 to 2000 the population of Greater Dhaka was about 3.44 million to 10 million that is at an average rate of 5.5%, but at that time the built-up area increased from 104sqkm (39% of the whole city) to 150sqkm (55% of the whole city) (Ahamad M.). In order to cope with this growing population problem, the government of Bangladesh has taken few steps to address the problem by making Draft National Housing Policy 2014 (GED, 2015). Most of the city planning initiatives failed to predict the population growth and growth of the city in terms of

spatial boundary (Nabi et al. 2004). Also the in migration in Dhaka city is still very high due to lack of national urban policy (Mahmud, 2007).

2.2 HOUSING SECTOR IN DHAKA CITY

2.2.1 OVERVIEW ON HOUSING SECTOR

As per Bangladesh Bureau Statistics 2011 report, there are 31.86 million housing units available in the country, out of which 7.3 million (27%) were in the urban areas and the remaining 24.59 million (78%) were in the rural areas (Forests, 2016). Semi-pucca and pucca housing together constitute about 64% of all dwelling units in the urban areas, the proportion of pucca housing went up from 22% to 32% from 2001 to 2011 which indicates that temporary housing structures are gradually being replaced by concrete or semi-pucca units (Forests, 2016).

The demand of housing in Dhaka city is dramatically increasing due to increasing population growth and its fast growth rate (Ahamad M.). Dhaka Metropolitan Development Plan (DMDP) 1995-2015 outlined neighbourhood as the smallest unit of Spatial Planning Zone (SPZ) where people live together and share the common facilities (Nahrin, 2008). DMDP also outlined that only about 70% land of the total residential project will be permitted to sell as residential plots and the remaining 30% of the land will be available for different community services and facilities (Nahrin, 2008). It is found that 30% of total population of Dhaka city has already covered 80% of residential areas with human settlement and supportive infrastructures (Barua et al. 2010).

As Dhaka is surrounded by rivers which make it difficult for the horizontal expansion of the city so to accommodate its residents the only solution is to go vertically up (Kamruzzaman & Ogura). Thus, the emergence of multi-storied residential buildings in Dhaka city. The concept of living in multi-storied residential apartment building is a new phenomenon among the residents of Bangladesh that evolved due to the structure of the metropolitan society and the job structure that created preference for nuclear family to replace the traditional joint family (Rashid). Those who are living in this kind of apartments are seen to have changed their life-styles, thus changing the urban and social fabric from the classic single storied independent house to sharing smaller living units side by side with numerous other families (Kamruzzaman & Ogura).

Apartment living has gained much popularity in recent years (Kamruzzaman & Ogura). The growing population can only be accommodated by the constructions of multi-storey buildings since the land value in inner city is very high (Seraj & Seraj, n.d.). Therefore, the reasons behind the emergence of apartment buildings as mentioned by Kamruzzaman and Ogura, in their research are given below:

- a. Lack of proper maintenance of buildings
- b. Lack of flexibility in addressing modern urban needs
- c. Change in cultural values
- d. Changes in local lifestyles
- e. Modern functional requirement developed

In Dhaka, housing demand is estimated to be 60,000 units to be provided by Real Estate Developer companies and 200,000 units of replacement plus backlogs in every year (Barua et al. 2010). From a study it is found that from 2013 to 2016 the single family house demand is estimated to be around 30,000 to 40,000 units and demand for flats is around 75,000 to 100,000 units, from 2013 to 2018 the house demand is around 60,000 to 80,000 and flats of 90,000 to 125,000 units and from 2013 to 2026 the house demand is around 95,000 to 130,000 and flats of around 70,000 to 95,000 units (Ahamad M.). Therefore, it can be said that in the long run people are more interested to build houses in ten years time and for the demand is high for flat buying customers for short time period that is for three to five years (Ahamad M.). Due to rapid growth of city population, inadequate land for housing and high price of land are the main elements of housing problems which constitute 46%, 33% and 21% respectively (Khan, 2012). Many government agencies and private developers are catering for upper and upper middle income groups, whereas, 98% of city population belong to lower and middle income groups with housing problems (Khan, 2012). The middle income group combined represents approximately 28% of the city population but cover nearly 65% of the residential lands in Dhaka city (Rashid).

High-rise residential buildings which are usually above 10 stories high are becoming very common now a days since there is a deficiency in service infrastructures in the fringe areas and some other factors that have forced people to live in high-rise apartments especially in and around high class residential areas (Nabi et al. 2004) and also these buildings are a sensible answer to urban housing problem (Seraj & Seraj, n.d.).

The buildings in Dhaka city have an unsustainable and inefficient energy consumption pattern (Bahauddin et al. 2014) such as Purbachal New Town and Uttara 3rd phase development plan lacks the provision of introducing modern futuristic amenities and sustainability (Hasnat & Hoque, 2016). About 50% dwellers of Dhaka city live in slums (Seraj & Badruzzaman, 1997). RAJUK has classified around 1000 buildings in Dhaka as 'visibly' vulnerable and risky (RAJUK R. U., 2015). Also many inappropriate development practices are taking place such as housing growth without planning, informal practice, encroachment of environmental sensitive areas, violation of building rules (Ahsan, 2016).

The housing deficit in urban areas grew from 1.13 million units in 2001 to 4.6 million units in 2010 and it is predicted that the deficit will reach to 8.5 million units in 2021 if the investment does not keep pace with the growth of population (GED, 2015). Only 28% of the urban households live in pucca structures and rest in poor quality houses suggesting that in terms of both quality and quantity, urban housing presents a major policy challenge for Bangladesh (GED, 2015). Due to scarcity of land and parallel increase in housing demand has escalated the land price to an unaffordable range (Forests, 2016). The low-income groups and the poor are ultimately remained left out in urban development strategies and programs (Forests, 2016).

2.2.2 IMPACTS OF RESIDENTIAL BUILDINGS ON ITS SURROUNDINGS

The haphazard growth of housing sector has given rise to many problems as mentioned by Ahamad & Hasan, 2010 are loss of wetlands, lack of open space, traffic congestion, pressure on utility services and community facilities, land speculation, loss of habitat of fauna-flora and biodiversity, loss of productive agricultural land, lack of air and sunlight, noise and air pollution, fire hazards, slum and substandard housing condition.

The character of residential area being lost due to rapid urbanization, it is turning into overcrowded dirty localities which creates unhealthy environment for living and damage the beauty of the city (Ahamad & Hasan, 2010). Motijheel and Tejgaon turned into heat islands in 1995 due to cutting down of trees and filling up water bodies (Biswas et al., 2012). Motijheel, Tejgaon, Banani, DOHS, Gulshan, Uttara, Mohakhali, Panthapath, Kawran Bazaar to Farmgate were found to have higher temperature by 3°C-4°C compared with rest of the area in Dhaka city due to high usage of air conditioner (Biswas et al., 2012). Uttara Model Town project design was inherently

flawed with an over-concentration on the physical development of the residential estate for which it lacks open spaces in neighbourhood scale, and no meaningful attempt was made to integrate social activities that resulted in the lack of pedestrian walkways, social gathering space, safe playing space for children (Rashid).

2.2.3 OVERVIEW ON HIGH-RISE APARTMENT BUILDINGS

The rapid influx of population resulted in sky rocketing land prices which eventually became the source for the evolution of high-rise buildings (Ahamad M.). Due to scarcity, speculation and increasing demand, the price of land in the city is increasing at a phenomenal pace about 20 to 50 times since 1980s (Nabi et al. 2004 and Barua et al. 2010). High-rise apartment buildings have impacts related to economic, physical, social, cultural, psychological and other fields (Khan, 2012). Height has traditionally symbolized power and prestige, tall buildings showcase national technological progress and private economic status (Khan, 2012). In Dhaka city this type of residential buildings are becoming very purposeful as it seems very sensible solution to housing problems (Khan, 2012). There are about 60 tall buildings (residential and commercial mixed) in Motijheel commercial area, Eskaton, Mohakhali and Banani (Seraj & Seraj, n.d.).

Not much efforts made to understand the functional situation of high-rise apartment buildings, their economic and social role and their current market price or rent structure (Nabi et al. 2004). Also the non-engineered construction of high-rise buildings are making these risky as few of the buildings have already collapsed or tilted (Ferdous & Rahman, 2015). 90% of the high-rise residential buildings in Dhaka city do not meet the local construction standard as quoted by the government of Bangladesh (Ahsan, 2016).

2.2.3. 1 IMPACTS OF HIGH-RISE APARTMENT BUILDINGS

In a survey it was found that high-rise buildings were constructed without keeping adequate space between the adjacent buildings for the free movement of air for which the temperature had risen due to lack of ventilation (Biswas et al. 2012). The spiraling land prices that accompany high-rise buildings drive away the low income group and therefore, add to the acute slum conditions that are already prevailing in cities (Khan, 2012). Low height buildings adjacent to high-rise buildings are deprived of adequate sunlight and lacks cross ventilation (Khan, 2012). This type of buildings usually consume a huge amount of electricity as these are equipped with lifts, pumps, air

coolers, geysers, ovens, etc (Khan, 2012). These type of buildings create immense pressure on water supply system in Dhaka city as a result the demand cannot be meet by Water and Sewage Authority (WASA) and also on the electricity supply on the locality (Khan, 2012). These buildings pump out water with heavy pumps for which the surrounding households are deprived of water (Khan, 2012).

In the study by Seraj and Seraj, the following problems have been identified that arise from high-rise buildings are:

- a. Puts pressure on utility services like water supply, gas and electricity.
- b. Increases traffic congestion and parking problems
- c. Creates problems of light and ventilation for adjacent small buildings.
- d. Fire fighting problem
- e. Problems related to inadequate number of lifts
- f. Inadequate parking space
- g. Lack of community space
- h. Lack of children play area
- i. Socio-psychological problem

2.2.4 CHANGES IN LAND USE PATTERN: EFFECTS AND CONSEQUENCES

Dhaka city has inconsistent change in land use pattern which is creating crisis in residential areas or neighbourhoods and affecting the city life adversely (Nahrin, 2008). Vulnerability of the city increases by unauthorized usage of the buildings that is by changing the land use pattern (Ferdous & Rahman, 2015). Even in the planned areas of the city land use pattern is being changed by commercialization of the residential plots (Mahmud, 2007). Land use change such as commercialization of residential areas is dreadfully affecting the habitable environment of the city by creating traffic jam, noise, glare and threatens the safety of community life (Nahrin, 2008). It is found that a good number of residential plots have been subdivided into a number of smaller plots which deviates set back rules during building construction, forces densification, provides excessive pressure on public services, reduces area for plantation (Nahrin, 2008). In a survey it is found that many residential structures in Gulshan are occupied by non-residential functions which puts pressure on supply of utility services (Nabi et al. 2004). Violation in building height by adding more floors deviating from approved plan reduces visibility of the city and air circulation and creates sun block (Nahrin, 2008). Transformation of residential areas causes

insufficient community services and amenities for a healthy neighbourhood, shortage of open space, reduce the scope of social interaction, increase social insecurities, conflicts vehicular and pedestrian movement (Nahrin, 2008). Land filling and encroachment are recognized to be the main reasons for changing wetlands in the city (Islam, et al., 2010).

The defiance to follow land use plan creates traffic congestion, inadequate provision of utility services, air pollution, noise pollution, overcrowding, lack of privacy, insufficient parking facility, lack of accessibility, frequent water logging and affects the cost of providing public infrastructures and services such as roads, schools, water and sewage, garbage collection, transport, and mail delivery (Nahrin, 2008).

2.2.5 VIOLATION IN BUILDING CODE

Many land owners violate the building codes by deviating from the RAJUK approved floor plans during construction period without informing the concerned authority about the changes (Mahmud, 2007). Mahmud (2007) found out some of the violations done by the individual land owners while constructing buildings are:

- a. Not maintaining the setback distance of building from adjacent road
- b. Not maintaining the height of the building as per the approved plan and FAR calculation
- c. Not maintaining setback rules of building
- d. Changing the land use of the building type

In a survey it is found that the set back rules are violated by 96% in Khilgaon and Taltola, 92% in Lalmatia and Shyamoli, 96% in Mirpur and Kallyanpur, 96% in Bangshal and Tantibazar, 100% in Sabujbag and Mugdapara, Nikunja 2 by 96%, Gulshan and Banani by 78%, Uttara by 84% (Mahmud, 2007).

2.2.6 HOUSING PRACTICE IN DHANMONDI RESIDENTIAL AREA

Even in the early 80s, Dhanmondi was a very effective residential area with independent homes, lakes and a few corner shops but gradually the change in land use pattern by non-residential uses highly affected the quality and character of Dhanmondi residential area (Kamruzzaman & Ogura). From the study it was found that out of 256 studied buildings 37 buildings violated the building height by building more than six stories (Kamruzzaman & Ogura). More than half the number of residential plots are used for non-residential purposes, which includes shops and

stores, government and semi-government offices, show-rooms and warehouses of business firms, NGO offices, clinics, educational institutions, and manufacturing units (Nahrin, 2008). Subdivision of plots is very common practice of the land owners in Dhanmondi. Out of 1085 studied plots 360 plots were subdivided into 860 plots, which generated further problems, majority of which were subdivided into 2 to 3 plots by 80% and 13% respectively (Nahrin, 2008).

2.2.7. REAL ESTATE DEVELOPER IN DHAKA CITY

2.2.7.1 OVERVIEW ON REAL ESTATE DEVELOPER

The Real Estate sector in Bangladesh is the growth center for the development of an economy (Barua et al. 2010). In Bangladesh the Real Estate sector is one of the major sectors which contributes to the national economy and serves the fundamental human right to shelter (Ahamad M.). Real Estate business took off in Bangladesh in 1970 with only five registered firms. From the early 1980s the business started to flourish and showed robust growth. By 1988, there were 42 developers in business in Bangladesh. At present, more than 1500 companies are active in the real estate sector with 1081 of them registered with Real Estate & Housing Association of Bangladesh (REHAB) (Ahamad M.). This sector is one of the necessary and skilled arrangement required to tackle the ever increasing population growth in Dhaka city (Islam). It plays an important role in providing accommodation by constructing mid-rise to high-rise apartment blocks with necessary services and infrastructure facilities (Islam). The formal and informal developers are found to have transformed the building stock in many ways such as extension of original building, modifications, alterations and high-rise construction (Kamruzzaman & Ogura). These developers were the first to introduce residential apartments in early 1980s in locations such as areas near Eastern Plaza, Paribagh, Maghbazar, Siddeshwari, Shantinagar, Dhanmondi, Mirpur, Banani, Old and New D.O.H.S; Gulshan and Baridhara (Kamruzzaman & Ogura). The residential high-rise building construction increased in the range of 3-10% (Khan, 2012). This sector has met a small proportion of the national housing demand which is 60,000 apartment units in the last 20 years (Barua et al. 2010). The Real Estate Developer companies are currently supplying 8000 to 10,000 apartment units every year, whereas, the demand is estimated to be 60,000 apartment units in each year (Barua et al. 2010).

It works on the basis of demolishing the existing low-rise residential building(s) and constructing a new mid-rise or high-rise building(s) on the respective plot (Islam, n.d.). This is done by maximum usage of land in a planned way to accommodate more people in a comparatively small place (Ahamad M.). These companies undergo a negotiation of 60-40 or 50-50 share depending on the location of the land and give 40-50% of the apartments to the land owners and sell the rest of the apartments to buyers (Bahauddin et al. 2014). The most preferred locations in Dhaka for real estate business are Mirpur, Uttara, Dhanmondi, Mohammadpur and Bashundhara (Labib et al. 2013). The prime factors for selecting the location are budget, residential environment and community facilities which can be both in inner and outer city areas especially along the main thoroughfares (Labib et al. 2013). Other factors for the selection of location for buying flats are better communication with work place, near to educational facilities, biasness due to relatives living in the same area for long time and near to main road (Labib et al. 2013). It is found that the upper middle income group is in the highest number searching to purchase flats (Labib et al. 2013). The factors for the development of apartments as mentioned by Kamruzzaman & Ogura are:

- a. Desire to live within the city
- b. Increasing commercial market for apartments
- c. Profitable for both owners of land and developers
- d. Availability of loans from financial institutions
- e. Existence of flexible rules for development
- f. Reliable developers in the real estate
- g. Ownership of a few apartments and ready cash

The large unsatisfied middle-income class is expected to be boosting market for the real estate business as middle and upper middle class people have started to show more interest in buying apartments due to increased and unaffordable house rent (Barua et al. 2010).

2.2.7.2 CRITICISM ON PRACTICES BY REAL ESTATE DEVELOPERS

The buildings constructed by the Real Estate Developer companies do not focus on sustainability (Bahauddin et al. 2014) and do not follow minimum standards of building codes during construction (Ferdous & Rahman, 2015). Many developers take the opportunity of encroaching the wetlands as there is no maps or well-documented

records of wetlands of Dhaka city (Islam et al. 2010). Due to rapid population growth, high land prices and socio-economic development, encroachment upon open space, vegetation, peripheral agricultural land, wetlands, fallow land and water bodies is becoming a common practice among Real Estate Developers in Dhaka city (Ahsan, 2016). Many developers are encroaching Kallyanpur canal for housing scheme, and rampant land filling is affecting the sub flood flow zone (Ahamad & Hasan, 2010). They are also found to have encroached Kallyanpur retention pond area as well which is reducing the effectiveness of the pumping station resulting in water logging in the area (Ahamad & Hasan, 2010). The land developers are violating the proposals of the structure plan and urban area plan by land filling in the low land areas of Dhaka city (Mahmud, 2007). The Real Estate companies, public agencies and powerful individuals are violating the planning rules and standards of the plan (Mahmud, 2007). Substantial increase in built-up areas by the construction of buildings by Real Estate Developers created substantial increase in impervious area, obstructed natural drainage pattern and reduced detention basins which in turn lead to shortening of the run off concentration time and an increase of the peak flow (Mowla & Islam, 2013).

2.2.8 RAJUK

2.2.8.1 OVERVIEW ON RAJUK

Town Improvement Act 1953 (TI Act 1953) states that RAJUK is the legitimate authority to prepare land use plan for 590sq.km of Dhaka Metropolitan Area (DMA) and to ensure plan implementation, control development and manage the growth of Dhaka city (Nahrin, 2008 and Mahmud, 2007). The main purpose of forming RAJUK is to ensure a planned development, promoting healthy urban environment, reducing congestion and crowd, preventing development of conflicting land use and to achieve sustainable development of Dhaka city (Mahmud, 2007). Mahmud (2007) pointed out the legal responsibilities of RAJUK in controlling land use and growth of city under:

- a. DMDP 1995 which comprises of Structure Plan, Urban Area Plan and Detailed Area Plan
- b. Building Construction Rules 1996
- c. Town Improvement Act 1953
- d. Private Residential Land Development Rules 2004
- e. Wetland Conservation Act 2002
- f. Mahanagar Imarat Nirman Bidhimala 2006

In the Seventh Five Year Plan, 2015 it is mentioned that to ensure environmentally sustainable urban development the broad strategies for RAJUK will include decentralization of activities to regional centers and sub-centers, building proper linkage between land use planning and transport planning, providing affordable housing to all classes of people, providing better connectivity, strengthening development control functions and protecting environmentally sensitive areas (GED, 2015). It also states the strategic targets to be pursued by RAJUK in the Seventh Five Year Plan are as follows:

- a. To implement DAP
- b. To manage acute housing problem
- c. To protect flood flow zones
- d. Improvement of lakes, khals and other water bodies
- e. Construction of parking facilities
- f. Construction of apartment buildings
- g. Earthquake resilient urban development

2.2.8.2 CRITICISM ON THE PRACTICES OF RAJUK

Like many other Private Land Development Companies (PLDC), RAJUK is also implementing their housing project in the wetlands of Dhaka city (Islam et al. 2010), also National Housing Authority (NHA) along with RAJUK are filling up the existing retention ponds violating the DMDP law (Ahsan, 2016). In September 1996, a seven storied framed structure completely collapsed at Kalabagan which indicates that RAJUK has failed to ensure the structural safety of the buildings under its jurisdiction (Seraj & Badruzzaman,1997). High profile corruption is also widespread for which rules and regulations are frequently violated under the jurisdiction of RAJUK, leading to a poor living condition in the housing projects (Ahsan, 2016). In a study it is found that most of the buildings and housing companies are developing lands by violating Natural Water Bodies, Open Spaces, Playground and Park Protection Law, 2000 which again indicates the existence of corruption inside RAJUK (Ahamad & Hasan, 2010). People take the opportunity to violate the plans because of lack of law enforcement, strong monitoring during building constructions, shortage of building inspectors in RAJUK and its unwillingness to perform its duties according to law (Ahamad & Hasan, 2010 and Mahmud, 2007). Along with this problem people also take the advantage of violating some important proposals of DMDP as RAJUK failed

to prepare the DAP on time as per the guidelines of DMDP (Ahamad & Hasan, 2010). RAJUK failed to implement the planning standards of DMDP and planning rules of DAP (Ahamad & Hasan, 2010). The planned development of Dhaka city could not be achieved due to inappropriate planning permission process starting with land use clearance till building permission, and corruption that exists in RAJUK (Mahmud, 2007). The plan permission process in RAJUK is so complex, lengthy and harassing that people prefer to hire illegal agents to deal with the procedures by giving extra money to them rather than doing it by themselves and also in some critical cases, clients or developers manage the authority for land use clearances for particular areas where development is restricted for specific purposes (Mahmud, 2007). It is found that client hire dalal to avoid necessary delay by 53%, to avoid harassment by 22%, to avoid spending time running after it by 7%, to avoid complex process of plan approval by 13% and for other reasons by 5% (Mahmud, 2007). The files or plans are not approved properly and sites are not inspected as per given parameters (Mahmud, 2007). RAJUK is also accused of changing the land use pattern for two reasons- firstly under a mutual understanding of RAJUK officials and the plot owners and secondly sometimes under pressure from the powerful persons of the state (Mahmud, 2007). Due to high corruption and weak monitoring, RAJUK failed to control the violation of building construction rules which resulted in congested and unhealthy city (Mahmud, 2007).

2.3 URBAN HAZARDS

Bangladesh is exposed to natural hazards such as flood, river erosion, cyclone, drought, tornado, cold wave, earthquake, drainage congestion or water logging, arsenic contamination, salinity intrusion, etc. (GoB, April 2010). 75% of all disasters in Bangladesh originate from weather-climate extremes (GoB, April 2010). As the number of people increases, the number of vulnerable persons rises that is higher population density can increase the number of people who are exposed to hazards (IFRC, 2012).

Urban disasters as mentioned by Stott and Nadiruzzaman are found in

- a. Flood
- b. Water logging
- c. Earthquake with subsequent liquefaction
- d. Fire hazards

The risks are amplified due to physical, social and economic vulnerabilities inherent to urban areas, which themselves are intensified by a continuous process of urbanization (Stott & Nadiruzzaman). The built form or the housing sector in Dhaka city has a number of environmental consequences as mentioned by Ahsan, 2016 are as follows:

- a. Loss of biodiversity
- b. Ground water depletion
- c. Drainage congestion, water logging and surface water pollution
- d. Ground water depletion
- e. Flood
- f. Environmental pollution by solid waste

The physical environment condition has deteriorated to an extreme level such as in the case of air, dust and noise pollution, river pollution, traffic jam, etc. (Forests, 2016). The major causes of flooding and water logging are unplanned urbanization, encroachment, lack of co-ordination between government agencies, maintenance to the system and implement of pertinent laws (Islam et al. 2010). The communities in low-lying slum areas of Dhaka city are mostly susceptible to disasters due to their physical, economic and social vulnerabilities which heighten their poverty, marginality and disenfranchisement (Stott & Nadiruzzaman).

2.3.1 EARTHQUAKE

2.3.1.1 OVERVIEW ON EARTHQUAKE IN BANGLADESH

Bangladesh is surrounded by high seismic regions such as Himalayan Arc and Shillong Plateau in the north and the Arakan subduction collision system in the east and is located close to the boundary of two active Plates: the Indian Plate in the west and the Eurasian Plate in the east and north (Islam, et al., 2013 and Ferdous & Rahman, 2015). The Main Frontal Thrust Fault (MFTF) and the Dauki Fault (DF) are the principal components of the former system and the Naga Thrust Fault (NTF), the Arakan Mega Thrust (AMT) and the Chittagong-Tripura Fold Belt (CTFB) of eastern Bangladesh is a manifestation of the latter (Ferdous & Rahman, 2015). According to Comprehensive Disaster Management Programme-I (CDMP-I) (2009) there are three major active faults in and around Bangladesh which are Madhupur Fault, Dauki Fault, Plate-boundary Fault- all capable of generating earthquake of 7.0 magnitude (Ferdous

& Rahman, 2015). Bangladesh and surrounding areas experienced at least one thousand earthquakes in the last 100 years of magnitude greater than 4 on Richter Scale (Islam, et al., 2013). According to the statistics of Earthquake Observation Center, between January 2006 and May 2009, 86 earthquakes has hit Bangladesh of more than magnitude 4 on the Richter Scale, while Meteorological Department claimed that nine of those were of magnitude 5 (Biswas, et al. 2012). The region-wise seismic map, produced by BUET, shows that 43% of Bangladesh are highlands, 41% are of medium height and 16% are low and vulnerable (Biswas, et al. 2012). Some of the major earthquakes around the region includes the 1548 Earthquake, the 1664 Earthquake, the 1762 Earthquake, the 1869 Cachem Earthquake (Ms 7.5), the 1885 Bengal Earthquake (Ms 7.0), the 1897 Great Assam Earthquake (Ms 8.1), and the 1918 Srimongol Earthquake (Ms 7.6) (CDMP, n.d). A powerful earthquake needs at least 100-150 years to be originated for a particular region and Bangladesh is overdue as 113 years have passed by since a heavy tremor from Dauki Fault has hit the region (Rahman, et al. 2011).

2.3.1.2 OVERVIEW ONEARTHQUAKE INDHAKA CITY

Dhaka is an earthquake prone city due to its geographical and geomorphological set-up and unplanned construction of buildings (Ferdous & Rahman, 2015) and also as it is moving 30.6mm/year in the direction of north-east so it can generate an earthquake of magnitude 6.8 (Islam, et al., 2013). Earthquake Vulnerability Index (E.V.I.) of Dhaka city (1997) is second among twenty vulnerable cities of the world based on population density, unplanned urbanization, non-compliance of building codes, narrow road network, lack of preparedness, insignificant awareness among the city dwellers and decision making (Ferdous & Rahman, 2015). Micro-seismicity data shows the existence of four earthquake source points in and around Dhaka (Islam, et al., 2013). On March 18, 2012 Dhaka was shaken by an earthquake whose epicenter was at Dohar Upazilla of Dhaka and as per Meteorological Department it was the first time in 162 years that an epicenter was so near Dhaka, specifically 15.7km deep inside the earth and 24km from Dhaka as per US Geological Survey Department (Biswas, et al., 2012). A strong earthquake affecting Dhaka may result in massive damage and destructions and may have disastrous consequences for the entire nation (CDMP, n.d). A low to moderate level of earthquake may cause severe damages to the lives and properties that may go beyond the existing capacity of DCC (CDMP, n.d).

2.3.1.3 EARTHQUAKE RISK FACTORS FOR DHAKA CITY

Ferdous and Rahman (2015) have mentioned in their study about the five indicators of the conditions of social vulnerabilities of the citizens at risk due to:

- a. Socio-economic conditions
- b. Building uses
- c. Availability of contact numbers of fire stations at household level
- d. Awareness and preparedness of earthquakes during the occurrence of the event
- e. Building ownership

Dhaka city is vulnerable to earthquake due to:

- a. High density population
- b. Unplanned infrastructures
- c. Close proximity with India and Myanmar's active seismic area
- d. Poor economic condition
- e. Poor emergency preparation and recovery capability (Rahman, et al. 2011)

2.3.1.4 EFFECTS OF EARTHQUAKE IN DHAKA CITY

Dhaka is located in second zone (medium) in terms of earthquake severity in Bangladesh (RAJUK R. U., 2015). A recent survey by Geological Survey of Bangladesh suggests that the Eastern Fringe of Dhaka lie within high to very high liquefaction susceptibility range for which if an earthquake either from Madhupur of Dauki Faults originates then it may cause severe liquefaction effects to buildings constructed on the marshy lands on the eastern and western fringes and also within the city areas like Begunbari and parts of Mirpur where the lands are filled with sand and garbage materials (RAJUK R. U., 2015).

Considering likely earthquake threat in Bangladesh, the CDMP under the Ministry of Food and Disaster Management of the Government of Bangladesh developed likely scenarios of earthquake for Dhaka which are as follows (CDMP, n.d) :

Scenario 1: An earthquake of 7.5 Mw originated from Madhupur Fault

Scenario 2: An earthquake at 8.0 Mw originated from Plate Boundary Fault-2

Scenario 3: An earthquake at 6.0 Mw originated from beneath the city

Table 1: Expected damages in DCC area under the 3 scenarios

Elements	Scenario 1	Scenario 2	Scenario 3
Buildings	166,570 buildings will be moderately damaged which makes up 51% of total buildings.	93,605 buildings will be moderately damaged which makes up 29% of total buildings.	136,434 buildings will be moderately damaged and 53989 buildings will be damaged beyond repair.
Fire Hazard	920 ignitions will burn 4.12sq.mi that is 9.04% of city area, 701,134 people will be displaced by fire.	918 ignitions will burn 4.08sq.mi that is 8.95% of city area, 726,606 people will be displaced by fire.	920 ignitions will burn 4.22sq.mi that is 9.26% of city area, 730,857 people will be displaced by fire.
People	Considering casualty takes place at 2:00am when the residential occupancy load is maximum: 18,000 people will be killed immediately, 9000 people will require hospitalization and life threatening, 50000 people will require hospitalization and not life threatening 150000 people will require first aid	Considering casualty takes place at 2:00am when the residential occupancy load is maximum: 2000 people will be killed immediately, 1000 people will require hospitalization and life threatening, 7000 people will require hospitalization and moderate injuries 24000 people will require first aid	Considering casualty takes place at 2:00am when the residential occupancy load is maximum: 13,000 people will be killed immediately, 7000 people will require hospitalization and life threatening, 38,000 people will require hospitalization and moderate injuries 110,000 people will require first aid
Hospital, police station and fire service	197 hospitals or clinics will be damaged, 21 police station and 4 fire service will be moderately damaged	22 hospitals or clinics will be damaged, police station and fire service will be remain normal	178 hospitals or clinics will be damaged, 17 police station and 4 fire service will be moderately damaged
Water, waste water and gas supply systems	79 leaks and 272 breaks in water supply system, 107 leaks and 360 breaks in waste water system, 56 leaks and 191 breaks in gas supply network		39 leaks and 139 breaks in water supply system, 58 leaks and 202 breaks in waste water system, 26 leaks and 94 breaks in gas supply network, All 7 points of natural gas system will be completely damaged

2.3.2 FLOOD

2.3.2.1 FLOOD IN BANGLADESH

Each year in Bangladesh about 26,000 sq.km, 18% of the country is flooded. During severe floods, the affected area may exceed 55% of the total area of the country. In an average year, 844,000 million cubic metre of water flows into the country during the humid period (May to October) through the three main rivers the Ganges, the

Brahmaputra-Jamuna and the Meghna. This volume is 95% of the total annual inflow. By comparison only about 187,000 million cu m of streamflow is generated by rainfall inside the country during the same period. The floods of 1987, 1988 and 1998 were catastrophic, leading to widespread destruction, misery and loss of life. The severity of the floods of 1987 and 1988 led the government to look for a plan, which would in the long term provide a comprehensive and permanent solution to the recurrent flood problem. Several major studies were taken up in 1989. These studies led to formulation of the Flood Action Plan (FAP) in 1989. The return period for a 1988 flood was estimated at 70 years but in just 10 years another flood occurred in 1998 (Banglapedia, 2015).

2.3.2.2 FLOOD IN DHAKA CITY AND ITS EFFECTS

Of the nine cities in the world lying at a highest risk zone of flooding, Dhaka stands second (Biswas, et al., 2012). Flood problems are serious in the cities due to high population density and inadequate drainage facilities. Major floods in the Greater Dhaka area have occurred in 1954, 1955, 1970, 1974, 1980, 1987, 1988, 1998 due to spillover from surrounding rivers (Huq & Alam, 2003). During the floods of 1987 and 1988 about 200sq.km. of the total 260sq.km. area of Dhaka city was submerged to depths ranging between 30 to over 450cm affecting 4.8million people for a period of 4weeks (Seraj & Badruzzaman, 1997). Over 40% of Dhaka was inundated during the floods of 2004 and 2007 each (Thiele-Eich, et al., 2015). Local flooding due to poor drainage affects the 65% of slums and squatter dwellers and 22% of city dwellers are regularly flooded during minor rainfall (Thiele-Eich, et al., 2015).

The 1988 flood inundated the entire eastern and low-lying western part of Dhaka by 85% with depths of inundation ranged from 0.3 to more than 4.5m and 60% of city dwellers were affected and it disrupted city life, air travel and communication from the capital city to the outside world and an estimated 400,000 houses were affected (Yahya, et al., 2010 and Huq & Alam, 2003). The 1998 flood was the most severe flood in terms of extent and duration which inundated 56% of the city for about 69 days including most of eastern part and 23% of the western part which is flood protected and this shows that the current flood management practices need improvement (Yahya, et al., 2010 and Huq & Alam, 2003). The western side of Dhaka is protected by embankment whereas, eastern side consists of low-lying floodplains that get submerged during the monsoon season (RAJUK R. U., 2015).

The water depth in some areas may be as high as 40-60cm, which creates large infrastructure problems for the city, economic losses in production, and damage to existing properties and goods. The ground floors of most buildings were inundated by 1998 flood from Balu River in Dhaka east- residential areas such as Basabo, Mugdapara, Uttar Badda, and Joar Sahara were the worst affected. In the west this flood submerged Mymensingh Road, Progoti Sarani, DIT Road, Biswas Road and worst flooding problems were faced by Mohakhali, Gulshan, Banani, Badda, Baridhara, etc. for 30 days, short duration flooding was observed in the areas of Shantinagar, Nayapaltan, Rajarbagh, Dhanmondi, Azimpur and Green Road. During 1998 flood 262,000 housing units were affected which is 30% of 860,552 units of DMA- 32% were permanent and semi-permanent structures belonging to wealthy people, about 36% units belonging to lower middle income people, nearly 32% of units from jhupri types belonging to the poor. The total damage on housing, infrastructure, industry, commerce was estimated to be US\$ 41 million(Huq & Alam, 2003).

2.3.2.3 CAUSES OF FLOOD IN DHAKA CITY

The country tends to have more devastating floods because of higher sea levels due to reduced gradient of rivers, higher rainfall in the Ganges-Meghna-Brahmaputra river basins and melting of glaciers in the Himalayas (Yahya, et al., 2010). Urban flooding particularly in low lying areas in the western part of Dhaka is caused due to accumulation of water from heavy rainfall, waste water from households and industries and septic wastes in wetlands and canals (Yahya, et al., 2010). Due to unauthorized and uncontrolled filling of low lying areas and khals and subsequent development of the infrastructure, the planned flood control activities are hampered leading to urban flooding with destructive effects (Yahya, et al., 2010). Flooding due to rainfall is also a severe problem that can inundate Dhaka for several days mainly due to drainage congestion (Huq & Alam, 2003).

RAJUK (2015) has indentified the issues of Dhaka flood scenario which are as follows:

- a. All sides of Dhaka are surrounded by rivers and canals
- b. Above 50% of Dhaka is low-lying and inundated during monsoon
- c. Filling of water retention areas and drains increase the risk of seasonal flooding
- d. Encroachment of rivers and canals can increase flood hazard susceptibility

- e. Internal drainage congestion can make the flood situation more complex
- f. Poor or no enforcement of laws in protecting the low-lying areas or wetlands in and around the city.

Biswas, et al. (2012) have stated the reasons for the occurrence of flood in the city:

- a. Illegal occupation of low-lying areas (Biswas, et al., 2012).
- b. Illegal occupancy of the marshy bodies and channels for drainage
- c. Decrease of the capacity of the land to absorb excessive rain water

2.3.3 WATER-LOGGING

2.3.3.1 OVERVIEW OF WATER-LOGGING IN DHAKA CITY

In a report on Strategic Environment Assessment of Dhaka, water logging has been identified as one of the major problems of the city. It is becoming a social menace and is having harmful effects on the social life, financial condition and structural casualties (Biswas, et al. 2012). During monsoon rains, many areas of Dhaka go under water, because canals being the primary drainage system of the city are blocked and cannot carry the huge volume of storm water. The canals which previously flew through the capital have been mostly filled and buildings have been constructed therefore smooth flow of water is hampered giving rise to water logging (Biswas, et al. 2012). In recent years, main streets go under a meter of water after heavy monsoon shower (Islam, et al., 2010). Most part of Dhaka city gets water-logged and several areas go under 30 to 60cm of water whenever it rains continuously for some time (Seraj & Badruzzaman, et al., 1997). Substantial increase in built-up areas through private land developers and real estate business resulted in substantial increase in impervious area, created obstruction to natural drainage pattern, and reduced detention basins, which in turn lead to shortening of the runoff concentration time and an increase in the peak flow that eventually causes water logging (Mowla & Islam, 2013). With normal rainfall one-third of Dhaka is water-logged (Biswas, et al. 2012).

2.3.3.2 EFFECTS OF WATER-LOGGING

Water-logging creates environmental and health hazard in the city along with social and physical problems such as diarrhoea, malaria, skin disease, dysentery, typhoid, traffic congestion, difficulty in movement both on foot and vehicles (Islam, et al., 2010). The brick foundation loses its longevity by being affected with corrosive

effect of salinity and dampness is the after effect (Islam, et al., 2010). Mowla and Islam (2013) have identified the effects of water logging which are as follows:

- a. Social Problem
 - i. Disruption of traffic movement
 - ii. Disruption of normal life
- b. Physical Problem-
 - i. Damage to infrastructure
 - ii. Damage to structures
- c. Environmental Impact
 - i. Water pollution
 - ii. Increase of water borne diseases
 - iii. Damage of vegetation and reduce aquatic habitats
- d. Economic Problem-
 - i. Increase of construction and maintenance cost
 - ii. Shortage of water
 - iii. Loss of income potential

2.3.3.3 WATER-LOGGING DUE TO REDUCTION IN WETLANDS

Previously the rivers surrounding Dhaka city were used to help in the sewage system, communication and means of transport and growth of business. But due to grabbing of rivers, filling up, pollution- the rivers are nearing extinction. These filled up lands are being grabbed by illegal owners and they are constructing slums, residential and commercial buildings, factories, industries, brick fields, CNG stations and other infrastructures. Wastage materials from factories and residential buildings are directly falling into the river and polluting the river water. This has resulted in blocking of water flow out of Dhaka and thereby has given rise to water logging in several areas of Dhaka city (Biswas, et al. 2012). Uttara 3rd Phase which is now filled with sand for an expansion of planned residential area is the combination of floodplain and marshy land (Ferdous & Rahman, 2015). Soft and thick infill soil enhances the vulnerability of the buildings in Uttara area (Ferdous & Rahman, 2015). The main causes of wetlands loss are unplanned urbanization and earth filling for construction of infrastructures, wetlands are randomly being filled up by mainly real estate housing companies and government organizations (Islam, et al., 2010), irrational project implementation, canal bank encroachment by adjacent plot owners, disposing of waste into public water bodies (Mahmud, 2007).

Between 1989 and 1999, every year 502 acres of water bodies have vanished, from 1999 to 2005, the reduction was 1922 hectares, in 2012, 2500 hectares of water bodies have been covered up (Biswas, et al. 2012). North-eastern Dhaka, namely, Badda, Satarkul, Khilkhet, Rampura, Uttarkhan and Dakshinkhan were once water bodies-

90% of the area have been filled up with sand and transformed into residential area (Biswas, et al. 2012). The waterbodies and lowlands decreased by 32.57% and 53.58% respectively during 1960 and 2008 (Islam, et al., 2010). Due to loss of wetlands not only there has been problems in drainage and water logging but also it creates problems in ground water recharge capacity and loss of water reservoir (Islam, et al., 2010). The widths of Gulshan-Baridhara and Dhanmondi lakes have also decreased (Islam, et al., 2010). Decrease in lowlands can be found in south-eastern parts such as Boro Maghbazar, Eskaton, Modhubagh, Noyatola, East Rampura, Motijheel and Jatrabari, north-eastern parts such as Akon, Dobadia and Dumni area, south-western parts such as Aminbazar, Gabtoli, Adabor, Ramchandrapur, Katasur and Mohammadpur, north-western parts such as Diabari, Dhaur and Kamarpara (Islam, et al., 2010). In the recent time, RAJUK has earth filled about half of the width of Banani-Gulshan lake and allotted plots (Seraj & Badruzzaman, 1997). Unregulated disposal of garbage, many of which are non-biodegradable, in the canals have also filled them up (Seraj & Badruzzaman, 1997). About 3000sqm of natural water bodies have already disappeared during the Riverview Housing Estate development on the Buriganga River bank's southern fringe, about 2300sqm of water bodies were filled in during the development of Bashundhara and Bashumoti Housing estates (Yahya, et al., 2010). In 1996, there were 211 acres of water bodies in the Mohammadia Housing Estate and Adabor area, about 91 acres of water bodies disappeared between 1996 and 2006 and 68 acres between 2006 and 2009 during development in that area (Yahya, et al., 2010). Even after the enactment of the Water Body Conservation Act 2000, the city has lost huge amount of wetlands (Mowla & Islam, 2013). If the current rate of loss of wetland continues, then by the year 2031 all temporary wetlands of Dhaka will disappear (Mowla & Islam, 2013).

2.3.4 FIRE

2.3.4.1 OVERVIEW ON FIRE HAZARDS IN DHAKA CITY

The development trend of the city took place in a haphazard and unplanned manner with little or no attention to the issue of land use and structural planning which leads to increase occurrence of fire hazards. The fire hazard vulnerability in the city has increased due to reckless building construction and non-conformation of Fire Protection Act, 2003. Most of the highrise buildings are constructed without

maintaining planning rules and regulations and lacks fire safety and emergency exit (Islam & Adri, 2008). Fire incident records within the Dhaka city shows that the zones of industries, slums and squatter settlements and some old parts of Dhaka are at greater risk of fire hazards compared to planned residential blocks, commercial blocks and fringe areas (RAJUK R. U., 2015). The residential and commercial fire in Dhaka is alarmingly increasing compared with the industrial fire. Dhaka has no formal zoning according to the fire risk vulnerability. Absence of street fire hydrants and fire-lanes in such over crowded city, the authority often face serious difficulties in the fire management. Dhaka is gradually losing its natural reservoir, the city has no plan yet to develop street fire hydrant system. The Ordinance of 1959 can provide fire licence only to warehouse and industry but not for residential, commercial and other category. Also the existing manpower of RAJUK is not sufficient to monitor and enforce the building code properly. At present, the authority has no contingency plan and sufficient preparation to avoid large-scale fire disasters (Islam & Adri, 2008).

2.3.4.2 FACTORS OF FIRE HAZARD IN DHAKA CITY

Absence of fire prevention code, lack of fire exits, inadequate fire drill, setting of industries in residential buildings and mushroom growth of slums—all are contributing to the ever increasing number of fire incidents in Dhaka city (Seraj & Badruzzaman, 1997). Electric Short Circuit is the main cause of fire in Dhaka city, kitchen burner being the second cause of fire (Islam & Adri, 2008).

RAJUK (2015) has mentioned the issues for Dhaka fire hazard scenario are:

- a. Lack of open spaces and scarcity of readily available water sources in neighbourhood can accelerate the exposure to fire vulnerability.
- b. On an average 80% of the roads are twisted, narrow and unplanned that can obstacle fire-fighting and ambulance to enter into the spot.
- c. High traffic congestion all over Dhaka city can delay to respond by the fire-fighting to control the fire event.

Islam and Adri (2008) have identified the factors associated with fire accidents in Dhaka city are:

- a. Lack of proper precautionary measures
- b. Institutional inefficiency
- c. Insufficient equipment support

- d. Poor technology
- e. Lack of public awareness
- f. Insufficient existing planning rules and laws
- g. Rapid unplanned urbanization
- h. Inadequate trained manpower

2.3.4.3 FIRE INCIDENTS IN DHAKA CITY

There were 657, 707, 706, 670 fire hazards in the year 1995, 1996, 1997 and 1998 respectively. The reported fire incidents from 2004 to 2006 in Dhaka city were 803 and 984 respectively. A total of 158 people were killed and the property worth about Tk 3838.69 million was burned in 6454 fire incidences from 2001 to 2007. A total of 1040 fire accidents occurred only in 2007, of which 252 occurrences were respectively in slum, industrial, residential and commercial areas. There were 302 residential and 306 commercial fire accidents against only 129 industrial fires reported in 2007. There were 407, 550, 490 fire incidents due to electric short circuit in the years 2007, 2005 and 2004 respectively and in 2007 almost 105 fires originated from kitchen burner.

2.3.5 GROUND WATER DEPLETION

Groundwater level in Dhaka city has receded in past years with low river levels further depleting the available water resources (Thiele-Eich, et al., 2015). It is depleting at an alarming rate having the worst situation in the central part followed by the south-western part. Expanding population along with the deliberate establishment of deep tube wells, reduction of recharge capacity due to rapid growth of urban structures and climate change altogether result in huge drop of water level throughout Dhaka. The city's ground water level has dropped about 20m over the last seven years at a rate of 2.81m per year and from the year 2000, the rate is increasingly high (RAJUK R. U., 2015). According to the statistics of Water Aid Bangladesh, every year, on an average, quantity of underground water is reduced by 2 to 3% (Biswas, et al., 2012). Between 1991-2008, amount of ground water in Mirpur area of Dhaka city has been reduced by 53.75%, Mohammadpur by 18.59m, Sabujbagh by 37.8m, Sutrapur by 8.22m, Cantonment by 14.14m (Biswas, et al., 2012). Encroachment on to water bodies, open spaces and the dumping of garbage in water bodies decreases the areas for rainwater recharge to underground aquifers. Over extraction of ground water from water supply in the city by the DWASA has resulted

in lowering the ground water table (Ahsan, 2016). There are 1500 legal and 2000 illegal deep tubewells are pressurizing the ground water level (Biswas, et al., 2012).

RAJUK (2015) has identified the issues of ground water depletion for Dhaka city are:

- a. In Dhaka about 48% of area is urbanized/ built-up that cannot help percolate water into ground water.
- b. Authority highly dependent on ground water to serve the citizens
- c. Very limited alternative sources of water supply and water of rivers located around Dhaka is highly polluted.

2.3.6 SEWAGE SYSTEM CONGESTION

Both the flood of 2004 and 2007 led to faecal contamination of drinking water sources in Dhaka due to drainage congestion problems(Thiele-Eich, et al., 2015). The city is protected from river flooding by an encircled embankment called Buckland bund and the Western Flood Protection Embankment, further obstructing the natural drainage system (Mowla & Islam, 2013). The drainage problems have become severe due to encroachment on the wetlands by real estate developers (Ahsan, 2016). Encroachment on to environmentally sensitive areas have resulted in a considerable increase in impermeable areas, generating an obstacle to natural drainage pattern and reduced retention basins, which has led to flooding in Dhaka (Ahsan, 2016). DWASA utilizes the existing canals and sewage pipes to collect the waste water from different areas, carry the effluent to dispose, most of it, into surrounding river systems without any treatment (Mowla & Islam, 2013). About 40% to 50% of daily solid waste is collected and disposed by Dhaka City Corporation (DCC) and the rest is disposed of illegally by residents into the vacant lands, low lands, street, canals and drains (Ahsan, 2016).

2.4 NATIONAL POLICIES AND HOUSING REGULATIONS

Before devising or commenting on the current practices of the Real Estate Developer companies, it is necessary to understand and learn about the policies and regulations underlined in national law for the housing sector of Bangladesh. Also the disaster management system needs to be addressed in order to understand the extent of disaster management in this country and how the private sector such as Real Estate Developers can help mitigate the risks and acknowledge the roles assigned to them for managing disasters in this country.

The housing delivery system in Bangladesh are:

- a. Public Housing Subsystem
 - Housing by Public Works Department
 - Public Housing Sites and Services Subsystem
 - Development Authority's Sites and Services Scheme
- b. Cooperative Housing Subsystem
- c. Private Housing Subsystem
 - Private Formal Subsystem (land developers, real estate companies)
 - Private Informal Subsystem (individual house building)
 - Slum Subsystem
 - Squatter Housing Subsystem
 - Other Subsystem

The policy concerns in housing in Bangladesh are:

- a. Providing access to shelter for all has been recognized as a constitutional obligation by the government of Bangladesh from the beginning of Independence. Such a commitment was also expressed in the first FIVE YEAR PLAN (1973-1978) and all subsequent development plans.
- b. The latest FIVE YEAR PLAN, the Seventh (2016-2020), also makes explicit reference to housing for all
- c. The National Habitat Report, 1976 and the second Habitat Report 1996 had also declared housing as priority basic service provision for all.
- d. The Third National Habitat Report for Habitat III, at Quito, Ecuador, in October 2016, is also expected to spell out the government's strategy for housing for all.
- e. The most direct and elaborate expression of policy was adopted by the government in 1993- the objective was to make the government a facilitator in the housing sector enabling the private sector and the household sector in the provision of housing.
- f. The National Housing Policy recommends conservation of agricultural land, water bodies, hills and forests lands when undertaking housing development projects by the government or private sector developers.

Dhaka Structure Plan 2016-2035

1. Effective Land use Management for Livable Dhaka:
 - a. Improve development control system:
 - Strengthen the inspection/monitoring system after Building Plan Approval
 - Revise FAR to suggest zone-wise maximum limit ratio.
 - Preparation of regulations on land use for disaster risk reduction.
 - b. To promote compact urban development:
 - Utilize PUD concept for block-based housing development.
 - Make the urban centers as attractive place for living.
 - c. To revitalize Old Dhaka:
 - Revitalize the Old Dhaka through sensitive redevelopment, rehabilitation and preservation of traditional heritages.
 - d. To mobilize the under-utilized lands within the city.
 - Recast and improve the land use of the under-utilized areas.
 - Shifting of Cantonment and military facilities from the city center.
 - e. To protect conservation areas:
 - Consider “Special Conservation Zone” with stricter regulations to protect river and khals.
 - Enact pre-emption (Priority Purchase Right by government) for transaction within Flood Flow Zones and Water Retention Areas.

2. Affordable Housing for City Dwellers:
 - a. Plan for housing for city population in accordance with the need of the increasing population
 - b. Locate housing close to work places in a decentralized manner.
 - c. Increase housing supply for low and middle income group of people.
 - d. Create planned and environmentally sound housing neighborhood.

3. Affordable Housing for All:

Its goal is to increase the range of affordable and appropriate housing opportunities for low to moderate income.

 - a. To increase housing supply:
 - Promote infrastructure and services in the potential and Designated Housing Areas.

- Ensure adequate supply of land for new residential development.
 - Devise effective and workable housing financing mechanism.
 - Expedite and ease planning permission to increase rate of housing supply
 - Public sector housing agencies should play greater role as housing facilitator instead of housing provider.
- b. To economize use of housing land:
- Encourage Block Housing concept.
 - Discourage plot based housing development practice both by public and private sector agencies.
- c. To develop housing with easy access:
- Encourage to develop housing close to the transit station
 - Encourage housing development within designated urban centers.
- d. To increase low and middle income housing supply:
- Public sector should provide affordable housing to the low and middle income group.
 - Improve conditions in slum
- e. To ensure healthy and livable neighborhood:
- Create planned and environmentally sound housing neighborhood in the potential urban areas.

4. Public Services for Better Urban Living

- A. Water supply: Adequate safe water for all. To ensure sustainable and safe potable water:
- Encourage harvesting of rain water
 - Ensure ground water recharge keeping the building setback back space to remain unpaved.
- B. Solid waste management: Its goal is the creating of clean and pleasant living environment. To ensure effective management of solid waste.
- Locate collection points at proper places and prevent public nuisance
 - Take measures for GHG mitigation and low carbon development
 - Ensure greater private sector participation in waste management.

- C. Sewage and sanitation: Its goal is hygienic and affordable sanitation for all.
- Promote adequate hygienic public toilet facilities in all busy areas of urban centers.

5. Preserving Open Space for Recreation and Aesthetics

Its goal is to enhance livability through promotion of open space and heritage.

- a. To promote quality of life through enhancing open space:
 - Protect and preserve available recognized open space
 - Mark and secure future open space in advance in proposed urban areas.
- b. To create urban linkage through open space (pedestrian movement):
 - Create green network with RAJUK area
- c. To encourage urban and peri-urban forestry and greening

6. Resilience through Disaster Prevention and Mitigation

Its goal is to create highly responsive and resilient community in a safe and protected built and natural environment.

- a. To mainstream disaster management in the urban planning and development process:
 - Preparation of comprehensive risk sensitive land use plan
 - Preparation of multi hazard risk mapping of Dhaka
- b. To ensure efficient mechanism for identification, assessment and monitoring of disaster risks:
 - Ensure earthquake vulnerability assessment to selected housing area.
- c. To reduce the disaster risks of human life, property and cost:
 - Introduce retrofitting or regeneration mechanism for faulty, obsolete and dilapidated buildings.
 - Monitoring of flood protection embankments around the city
 - Introduce optimum plinth level of buildings
 - Monitor and forecast demand for existing and projected firefighting and evacuation facilities.
 - Building urban resilience to flood.

The Sustainable Development Goal II (SDG II)

It mentions the issues related to housing, urbanization and settlement patterns.

Housing issues are-

Table 2: . Housing issues, actions and implementing agencies

ISSUES	ACTIONS	IMPLEMENTING AGENCIES
Shortage of housing, stock supply, especially housing for the low-income groups.	Ensure adequate, safe and affordable housing and basic services for all by 2030.	NHA, City Development Authorities, NGOs, Private Sector (REHAB)
Problems of slum and squatter settlements	- Take action to improve/upgrade conditions in slums and squatter settlements as suggested in National Housing Policy -Avoid slum eviction as much as possible. -Ensure provision of land and housing for the poor in Urban Master Plans and Detail Area Plans.	NHA, RAJUK, CDA, etc.
Land supply and land tenure	-Ensure policy measures for proper proportionate/ judicious allocation of land for housing and economic activities for all income groups. -Conduct land ownership/ land use mapping in urban area.	Ministry of Land, UDD
Anarchy in Real Estate Development	-Bring the Real Estate Developers under strict regulatory measures -Proper financing institutions should be created to facilitate housing finance for the middle and lower income groups of people	MoHW, MoFP
Ecological sustainability of housing	New urban housing development must adopt both disaster risk resilient measures, as well as maintain ecological and cultural tradition.	NHA, UDD

The National Disaster Management Policy

The objectives are:

- a. To reduce the underlying risks by:
 - Integrating disaster risk reduction approaches and climate change adaptation in all ongoing and future development plans, programs and policies.
 - Enhancing professional skills and knowledge of key personnel on risk

reduction, preparedness warning and forecasting system, climate change risk reduction and post-disasters activities.

- Strengthening mechanisms to build capacities for the community and institutions at all levels.
 - Community based programming for risk reduction
 - Promote and facilitate the incorporation of longer term disaster risk reduction due to climate change into disaster management,
 - Promote livelihood strategies and options for poor that incorporates disaster management and risk reduction practices.
 - Strengthen capacities for risk assessment for flood, earthquake, drought, cyclone, pest attack, epidemics, including assessment of climate change risk.
- b. To establish and strengthen the systems and procedures for effective response management through:
- Creating a legal and institutional framework for effective response management.
 - Strengthening national capacity for response management with emphasis on preparedness and support to disaster management committees at district, upazila and union level.
 - Improving the early warning and community alerting system.
 - Strengthening search and rescue capabilities of relevant agencies.
 - Introducing an effective response management coordination mechanism including a relief management logistic system to handle different levels of emergency response
 - Establishing an electronic based information management system.

Disaster Management Act

It aimed at helping communities to:

- a. Mitigate the potential adverse effects of hazard event.
- b. Prepare for managing the effects of a disaster event.
- c. Effectively respond to and recover from a disaster or an emergency situation.
- d. Adapt to adverse effects of climate change.

National Plan for Disaster Management

Disaster Risk Reduction and adaptation to climate change strategies both are aimed at enhancing sustainability, resilient societies and human security. One of the scope of the Plan is to:

- Determine where responsibilities for prevention, mitigation, and preparedness planning and action should lie in the government, non-government (NGOs) and the private sector
- Identify by further detailed analysis who and what are vulnerable to the occurrence of these threats and how these are likely to be affected by them
- Investigate what measures are possible to prevent occurrence of the disaster events-what can be done to mitigate the effects of disaster events and what disaster preparedness measures can be put in place in anticipation of these.

Bangladesh Disaster Management Model

- a. Defining the risk environment involves both the traditional and formal hazard analysis:
 - Understanding the social, political and community environment.
 - Establishing the likely threats.
 - Understanding the likelihood and consequences.
 - Rank risks in priority
 - What can be done to eliminate, reduce or manage risk.
- b. Managing the risk environment.
- c. Responding to threat environment.

The Building Construction Rules 1984:

This seeks to redevelopment by containing some important provisions concerning monitoring and enforcement, mixed use, setbacks, preparation of new plans, plot size, out-line approval, site coverage, land use and building heights (Ahamad & Hasan, 2010).

The Building Construction Rules 1984:

It controls the development by imposing conditions on: setbacks, site coverage, construction of garage, access to plot, provision of lift, land use of that particular plot, and height of buildings (Ahamad & Hasan, 2010).

Building Construction Act 2006:

It provides more authority to RAJUK. Introduction of Floor Area Ratio (FAR). It provides rules of building coverage area, allowable floor space and relation among building height, road width and plot size (Ahamad & Hasan, 2010).

Private Residential Land Development Rule, 2004:

This contains the applicable rules for approval of land projects, area limit, and the maximum areas applicable for sale, land use, preserving the interest of the customers. 30% of the land should be conserved for provision of utility and civic amenities. The layout plan should be prepared such that the surrounding environment, beauty, transportation, water-logging, water and sewerage drainage and other concerning matters should be considered with proper care (Ahamad & Hasan, 2010).

MahanagarImaratNirmanBidhimala, 2008:

Importantly introduced FAR to manage the building coverage, allowable floor space and relation among the building height, road width, plot size. It eliminates mandatory height limitations of buildings and enables design of more livable and creation of open space through design flexibility, provision of natural light and air (Ahamad & Hasan, 2010).

Chapter 3

BACKGROUND OF THE STUDY

3.1 STUDY AREA

Dhaka is located centrally in Bangladesh and lies between East Longitudes 90°20' and 90°30' and between North Latitudes 23°40' and 23°55'. Dhaka Municipal Corporation and surrounding Thanas, usually known as Dhaka Metropolitan Area (DMA), have an area of 815.85sqkm with a population density of 14,608 person/sqkm. Dhaka is a megacity which spreads over 4 other districts covering an area of over 1400 sq.km with a population of 14.7 million. The annual population growth rate of Dhaka city is projected to be 3.82% between the years 2014-2030. The city enjoys a tropical wet and dry climate. In the monsoon season the annual average temperature is 25°C and nearly 80% of the annual average rainfall of 1854mm occurs in between May and September. Dhaka city is an alluvial plain consisting of fine sand and silt deposits with shallow ground water table. The Buriganga in the south, Turag in the west, Tongi Khal and Balu River in the east are the main streams that surround Dhaka. The major lakes are Dhanmondi Lake, Ramna Lake, Gulshan Lake and Crescent Lake. The major canals which are still used as open channel is Begunbari Khal, Abdullahpur Khal, Diabari Khal, Manda Khal, Digun Khal, Meradia- Hazari Khal and Kallayanpur Khal. The eight principal Thanas are Lalbagh, Kotwali, Sutrapur, Ramna, Motijheel, Paltan, Dhanmondi, Mohammadpur, Tejgaon and sixteen auxiliary Thanas are Gulshan, Mirpur, Pallabi, Shah Ali, Turag, Sabujbagh, Dhaka Cantonment, Demra, Hazaribagh, Shyampur, Badda, Kafrul, Kamrangir Cha, Khilgaon and Uttara. The elevation of Dhaka is only 5m above the mean sea level. The city is protected from river flooding by an encircled embankment called Buckland bund and the Western Flood Protection Embankment. Rainfall induced flooding occurs in the built-up areas of the inner city.

Dhaka is growing fast, which requires a growth management strategy for its orderly development in future. Dhaka's dominance is not in terms of population, but also in

terms of economy, trade, commerce and administration facilities. There are fears there would be a maze of unplanned urbanization with its spill-over effects on all sectors of the city's population. Dhaka being the capital and largest metropolitan city of Bangladesh with its employment opportunities and other commercial activities has attracted the largest number of migrants from all parts of the country. Along with the rapid urbanization, the civic facilities of the city is yet not developed in a proportionate manner. Whole economic, political and cultural activities are centered in Dhaka thus, making it more vulnerable.

3.2 SURVEY DATA ANALYSIS

3.2.1 SURVEY DATA ANALYSIS OF HOUSEHOLDS IN APARTMENT BUILDINGS

Fifty residential buildings are surveyed from different locations in Dhaka city mainly Dhanmondi, Uttara, Banani, Gulshan, Mirpur, Mohakhali, Mohammadpur, etc. as these locations are most desired by apartment buyers and most Real Estate Developer companies focus on doing business in these areas. At least one household from each building was surveyed to find out the problems of living in their apartment buildings. The objective of surveying the residents is to understand their perspective on sustainability and to have a clear knowledge about how well prepared are they for any disaster that might affect them directly or indirectly. Also they were enquired to find out their needs which can be useful to devise new design concepts and policies to improve the current building solutions provided by the Real Estate Developers.

Each household is enquired about fourteen issues focusing on their respective apartment buildings which are community facilities, security, fire safety, privacy, breathing space, parking, internal layout, solar panel, rainwater harvest, rooftop garden, water-logging, waste disposal, disaster awareness and disaster risk reduction. The data collected from fifty households are shown below:

1. **COMMUNITY FACILITIES:** Community facilities such as community room, office room, children play area, gymnasium, prayer room, rooftop activities such as bar-b-q space or recreation space are very useful for social interaction among the different families living together in one building. Through enhanced interaction many issues can be addressed among the residents such as how to fight fire in their respective buildings or how to keep

themselves safe during an earthquake, etc. Such interactive spaces need to be accepted by the residents therefore, their perspective on how these spaces should be incorporated to meet their needs by the builders needs to be addressed.

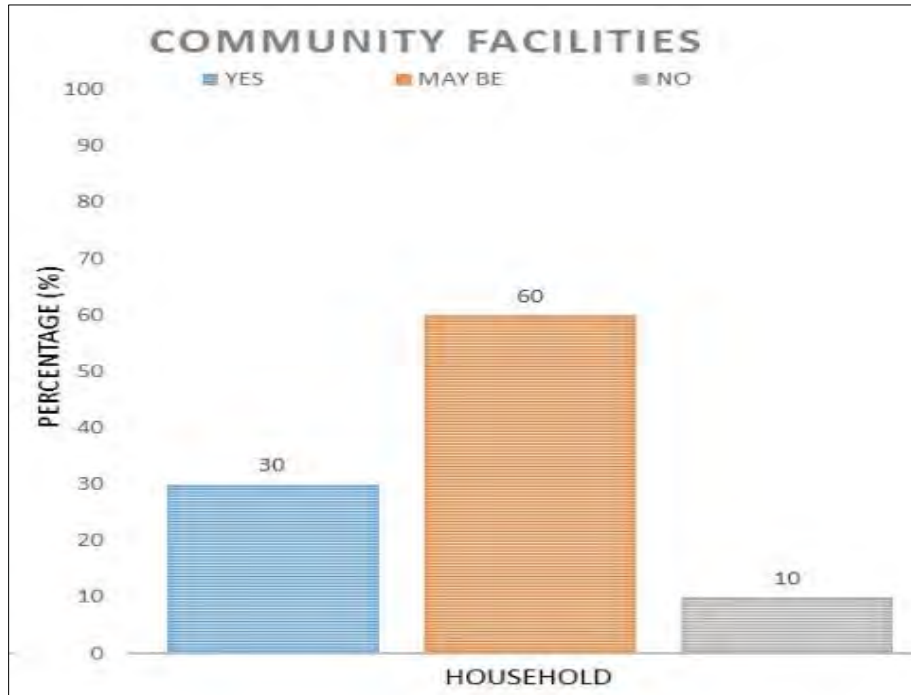


Figure 1. Types of community facilities required by residents of apartments

Each household is enquired about the types of community facilities needed by them are:

YES: 30% of the total households which said yes have shown interest in the community facilities such as community room, office room, children play area, gymnasium, prayer room, rooftop activities such as bar-b-q space, reception area, care taker's and driver's waiting space.

MAY BE: 60% of the total households which said may be have shown interest in the community facilities such as community room, office room, care taker's and driver's waiting space.

NO: 10% of the total households which said no have shown interest in care taker's room and no other community facilities are required.

2. **SECURITY:**Security is a very important issue for the apartment buyer. It is very necessary to make sure that the people residing inside the apartment building are secured all the time from possible thefts, robbery or other unfortunate incidences that can arise due to lack of awareness and carelessness such as intrusion of armed criminals into the building that can cause severe damage to residents and their assets. For this reason the residents were enquired about how they would feel more secured which can be addressed by the developers to enhance the security of their buildings.

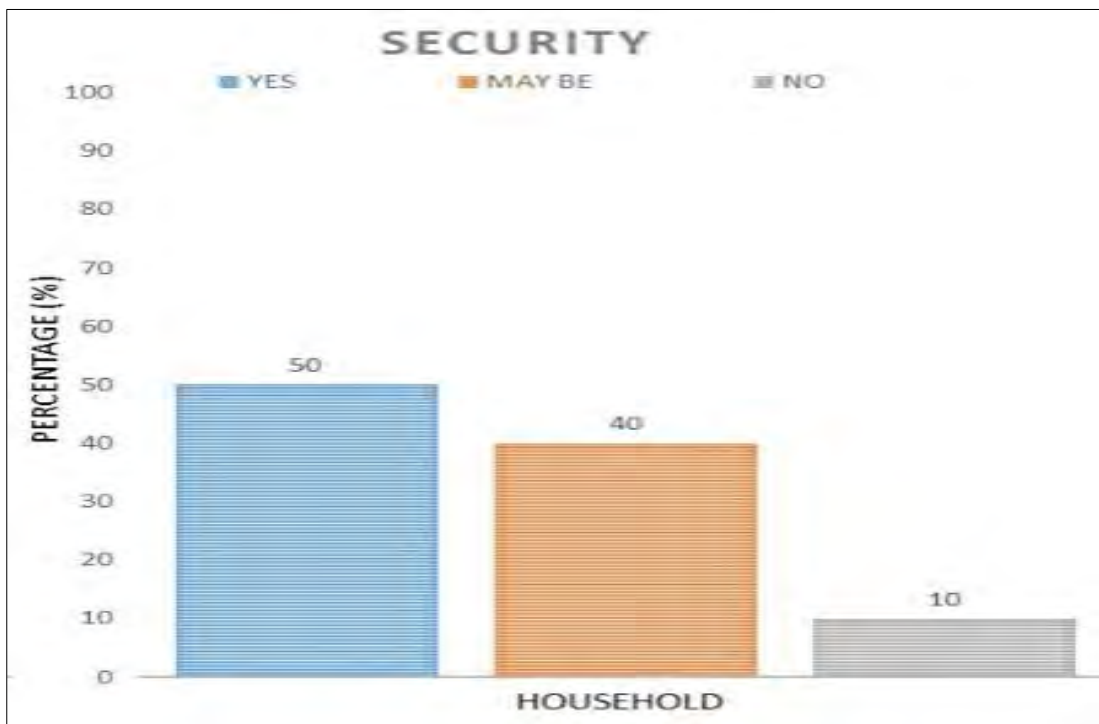


Figure 2. Types of security required by residents of apartments

Each household is enquired about the types of security systems needed by them are:

YES: 50% of the total households which said yes have shown interest in need of security by the installation of cc cameras throughout the building, standby security guard, intercom, and burglar alarm system,grilled openings

MAY BE:40% of the total households which said may be have shown interest inintercom connection, security guard, grilled openings.

NO: 10% of the total households which said no have shown interest in appointed security guard and provision of intercom only.

3. **FIRE SAFETY:** Fire incidents are becoming more frequent in residential apartment buildings. As a result, it has become mandatory to consider fire risks seriously and take actions to fight fire properly with the use of appropriate firefighting equipment such as fire extinguisher, fire hose reel, fire alarm system, sprinkler system, fire drills, etc. Their knowledge and willingness to comply with firefighting methods can help to design the firefighting system in a more effective way.

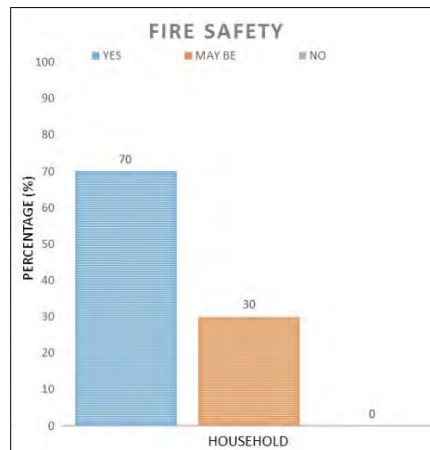


Figure 3. Types of fire safety required by residents of apartments

Each household is enquired about the types of firefighting systems needed by them are:

YES: 70% of the total households which said yes have shown interest in need of firefighting equipment such as fire extinguisher, hose reel, fire alarm system, sprinkler system in lobby, fire markings, fire drills.

MAY BE: 30% of the total households which said may be have shown interest in need of fire extinguisher, fire alarm system, fire drills.

NO: None have said that fire safety issues in a building are unnecessary.

4. **PRIVACY:** Ensuring privacy inside an apartment is a very important issue as our society is very conservative. Privacy within different units of the same building as well as privacy with neighboring buildings should be attained for healthy and peaceful living for the residents. For the buildings to run effectively privacy should not be hampered as this can create psychological problems in some residents. Also hampering privacy can also possess threats to some people.

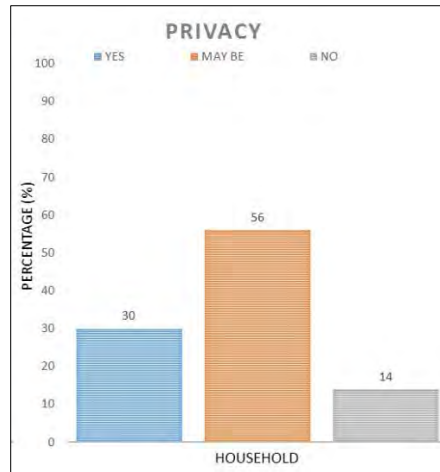


Figure 4. Privacy of residents in apartments.

Each household is enquired about the privacy problems faced by them are:

YES: 30% of the total households said that privacy problems between two or more units in the same building and other buildings persist.

MAY BE: 56% of the total households said privacy with the neighboring buildings might persist.

NO: 14% of the total households said privacy with other buildings and neighboring units do not persist.

5. **BREATHING SPACE:** For healthy living the residents need to be exposed to open spaces. In Dhaka, lack of open spaces mean that people are forced to stay indoors. Therefore, it has become necessary to incorporate breathing spaces inside the residential buildings for healthy mental and physical growth of the residents. Breathing spaces such as rooftop garden can create higher social interaction opportunities among the residents which can further develop their community.

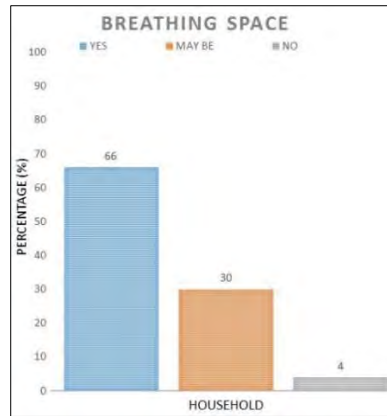


Figure 5. Types of breathing space required by residents of apartments

Each household is enquired about the types of breathing spaces needed by them are:

YES: 66% of the total households which said yes have shown interest in need for breathing space such as non-grilled balconies, planter box in balconies, green rooftop, well ventilated interior.

MAY BE: 30% of the total households which said may be have shown interest in need of rooftop garden.

NO: 4% of the total households said no breathing space is required.

6. **CAR PARKING:** The residents of the apartment buildings are enquired if the number of car parking spaces are sufficient for them. Their perspective on car parking tower will be a useful data to encourage more community based car parking tower instead of providing parking facilities on individual plots for respective buildings. It is necessary to understand how they would respond to such solutions as they will be the primary user group. If parking problems can be addressed by the developers in a more effective way then many other problems associated with car parking can be resolved in a cohesive way.

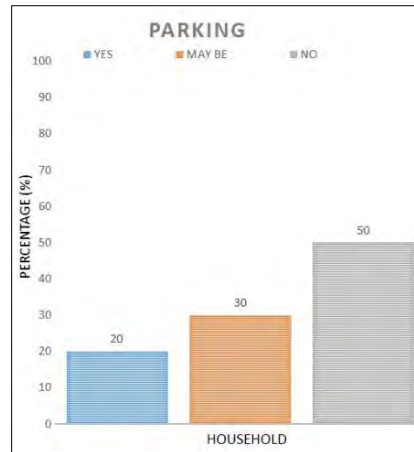


Figure 6. Apartment residents' view on car parking tower

Each household is enquired about its view on car parking problems and car parking tower are:

YES: 20% of the total households said there is no problem with parking facilities in their building and parking tower can be a good solution.

MAY BE: 30% of the total households said there is not sufficient parking and parking tower might be a good solution.

NO: 50% of the total households said no parking problem and car parking towers will not be feasible.

7. **INTERNAL LAYOUT:** Internal layout of the residential apartment building is associated with sustainable issues such as sufficient flow of natural air, sufficient openings for natural light, etc. Functional zoning is also a big concern as many apartments are left unsold or unrented due to lack of solved internal functional zoning. Therefore, the resident's point of view can explain how they would accept an apartment for their livelihood purposes.

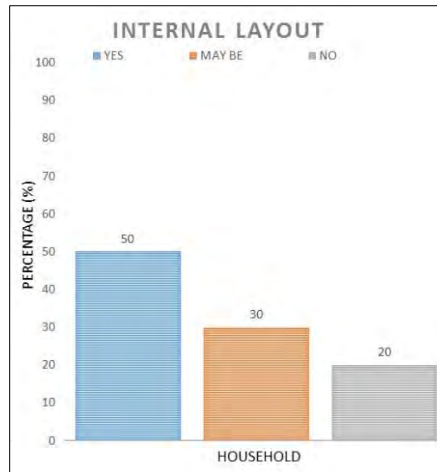


Figure 7. Problems in internal layout of apartments

Each household is enquired about problems in problems in functional zoning, privacy between public and private zones inside an apartment, natural air and light:

50% of the total household said yes for internal layout problems inside apartment, 30% said may be and 20% said no.

8. SOLAR PANEL: Use of solar panels in Dhaka city is becoming a common phenomenon. It is associated with sustainability therefore, use of solar panels by developers and the residents in their buildings is highly required. The residents are enquired about solar panels in order to understand how aware or how willing are they to attain sustainability by spending a bit more while buying an apartment.

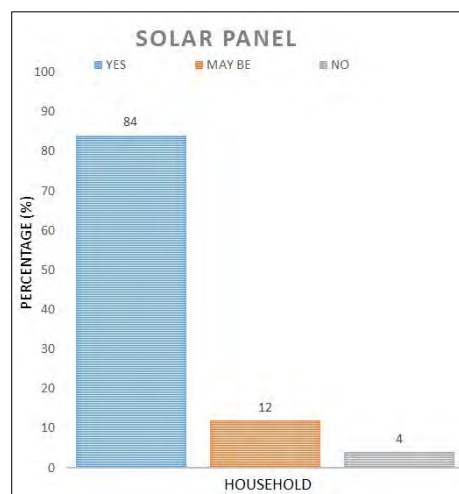


Figure 8. Apartment residents' view on use of solar panel in apartments

Each household is enquired if solar panels will be useful to them:

YES: 84% of the total households said solar panels are very necessary.

MAY BE: 12% of the total households said solar panels can be useful if many can be installed.

NO: 4% of the total households said solar panels are not useful/ does not generate large amount of electricity.

9. **RAINWATER HARVEST:** The residents of the apartment buildings are enquired if they will be willing to apply rainwater harvest system in their building as it is a sustainable solution for reducing water consumption from WASA which is dependent on ground water.

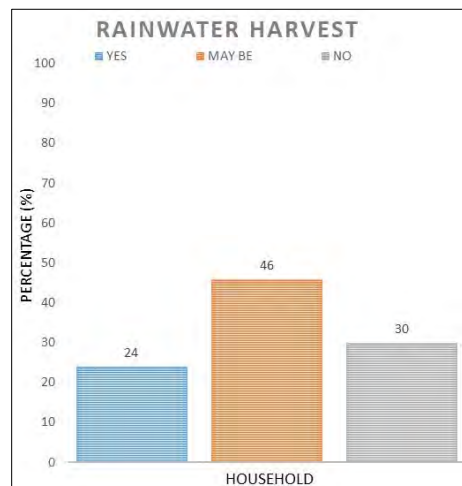


Figure 9. Apartment residents' view on rainwater harvest in apartments

Each household is enquired about harvesting rainwater collected from the rooftop can be useful to reduce the water consumption from WASA are:

24% of the total household said yes for the provision of rainwater harvesting system, 46% said it might be useful and 30% said no it will not be useful

10. **ROOFTOP GARDEN:** It is evident that the built-up areas of Dhaka city contribute to heat island that is being observed in the past few years. The unsustainable buildings being one of the contributors. Also due to lack of greenery and improper design of the buildings the interior of the buildings are found to be more heated than its exterior. By providing rooftop garden the overall heat in an individual building and its surrounding can be reduced. The

use of rooftop gardens in every residential building can have positive impacts. Therefore, the residents are enquired if the chances of buying an apartment or renting an apartment that has a rooftop garden in it will be more preferable to them or not. This will help to understand if the developer companies can incorporate this element in their building designs.

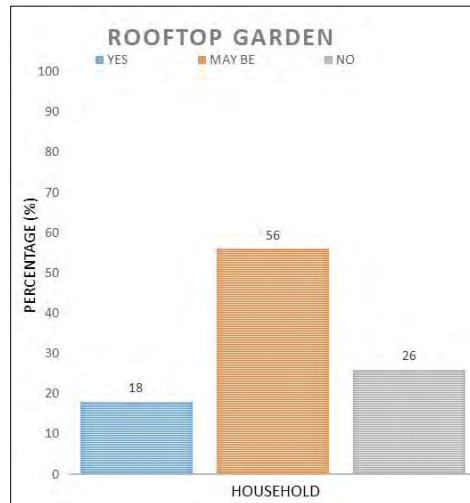


Figure 10. Apartment residents’ view on rooftop garden in apartments

Each household is enquired if rooftop garden will be preferable to them:

YES: 18% of the total households said rooftop garden can reduce heat, can create a sense of living close to ground, can bear maintenance cost, and adds beauty to the building.

MAY BE: 56% of the total households said rooftop garden can reduce heat, might be able to bear maintenance cost

NO: 26% of the total households said they cannot bear maintenance cost therefore no rooftop garden is required.

11. WATER-LOGGING: It is a very serious problem faced by the citizens of Dhaka city which imposes adverse health conditions. The residents of the apartment buildings are enquired if they have faced water-logging problems in front of their house or in their neighborhood. One of the reasons of water-logging in the city is due to extensive amount of built-up areas. If the buildings are sustainable then to some extent the water-logging problems might be solved in Dhaka city.

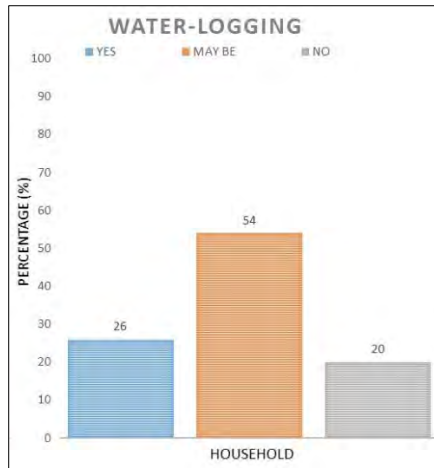


Figure 11. Water-logging problems faced by residents of apartments

Each household is enquired if they have water-logging problems:

YES: 26% of the total households said they have water-logging problems in front of theirhouses

MAY BE: 55% of the total households said they have water-logging in the neighborhood

NO: 20% of the total households said they do not have water-logging problems

12. WASTE DISPOSAL: Disposing waste (kitchen or sewage) in an ecological way means attaining sustainability. Dhaka city lacks a proper and healthy system of accumulating and disposing of kitchen waste. So it involves all the citizens to cooperate in order to make the environment liveable. Therefore, the residents are enquired if they will be willing to adapt to such systematic way of waste disposal such as using the 3R's system: Reuse, Reduce and Recycle.



Figure 12. Apartment residents' view on waste disposal system in apartments.

Each household is enquired if they would practice the 3R's system:

Kitchen waste disposal can be done in an organized and cleaned way following 3R's system: Reuse, Reduce and Recycle and categorizing the type of waste.

20% of the total household said they would apply the 3R's system, 66% said may be and 14% said no.

13. DISASTER AWARENESS: In recent time the residents of Dhaka city have experienced a few life threatening events such as earthquake, fire accidents in buildings, etc. This topic seeks to find out how well are the residents of the apartment buildings aware of such hazards and the level of their preparedness to withstand such disasters. This is important because their awareness can help to tackle such disasters in a more cohesive and effective way.

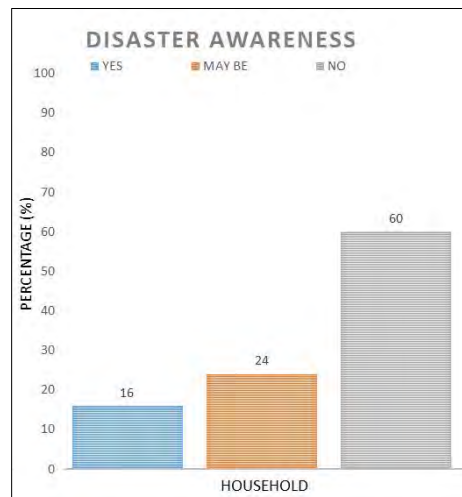


Figure 13. Apartment residents' view on their disaster awareness

Each household is enquired about earthquake and fire hazard awareness and preparedness:

YES: 16% of the total households said that they are aware about earthquake and fire hazard, can operate extinguishers, aware of fire exits, no contact number of BFSCDA, did not participate in earthquake or fire drills.

MAY BE: 24% of the total households said they are only aware of hazards and fire exits but cannot operate fire extinguishers, not aware of fire exits, no contact number of BFSCDA, did not participate in earthquake or fire drills.

NO: 60% of the total households said they are not well aware of such disasters and does not take any precautionary measures as no such incidents have taken place in their buildings.

14. DISASTER RISK REDUCTION: This is very beneficial in all stages of risk reduction. If the residents are aware of the risks of living in a multistory residential building before the occurrence of any tragic disastrous events then many lives and property can be saved from being damaged. For this reason the residents of the apartment buildings are enquired if they feel the need to reduce the risk factors to protect themselves by acquiring few simple skills and knowledge.

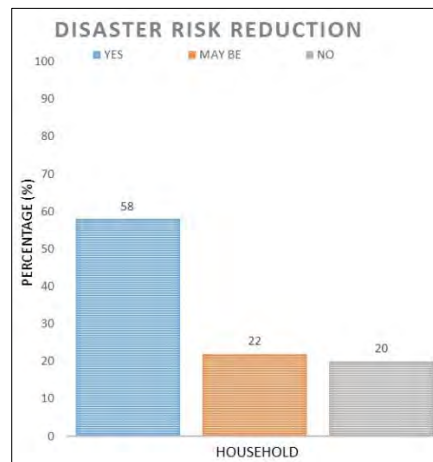


Figure 14. Apartment residents' view on disaster risk reduction

Each household is enquired if earthquake and fire drills will be useful, knowledge about fire exits and use of fire extinguishers can be very helpful, contacting BFSCDA during emergency would be effective

58% of the total household said it will be very useful to them, 22% said it might be useful to them and 20% said it will not be useful.

3.2.2 SURVEY DATA ANALYSIS OF BUILDINGS CONSTRUCTED BY SELECTIVE REAL ESTATE DEVELOPER COMPANIES

Since all the surveyed buildings could not be checked for violation in building codes due to lack of time and necessary resources, so another survey was conducted focusing at least six Real Estate Developer companies. These companies have more than fifteen years of experience in apartment building construction and have constructed over 50 residential buildings in Dhaka city. These companies are selected by analyzing the detail information from the list of registered members of REHAB.

It is necessary to study the plans designed by these leading companies as they are actively participating in the development of the housing sector and will continue to do

so as their business has already flourished. Therefore, the design faults and other necessary problems arising through their building designs need to be identified in order that in near future the problems can be overcome to create sustainable residential buildings. Five randomly picked residential buildings from each of the six chosen companies are studied and surveyed. The building approval plan drawing or simply RAJUK drawing and respected working drawings are compared to check if any violation in building code is carried out after approving the plans for construction from RAJUK. The sustainability issues of a building and how the buildings are designed for disaster management are also analyzed.

The building plans which were collected from the developer companies were analyzed on the following issues:

1. **BUILDING SETBACK:** The building setback refers to the space between the building and the respective plot line which varies from plot to plot depending on the size of the plots. The setback is required for many factors such as keeping sufficient gap/space between two or more buildings of adjacent plots to minimize hazards from earthquake and fire incidents, free flow of air and light between the two buildings so that all sides of the building can receive natural light and air. Setback spaces become very helpful at the time of crisis if sufficient or prescribed setbacks are ensured during building construction. For this reason it is necessary to check if the buildings constructed by renowned developers comply with the setback building codes for safety and sustainable issues.

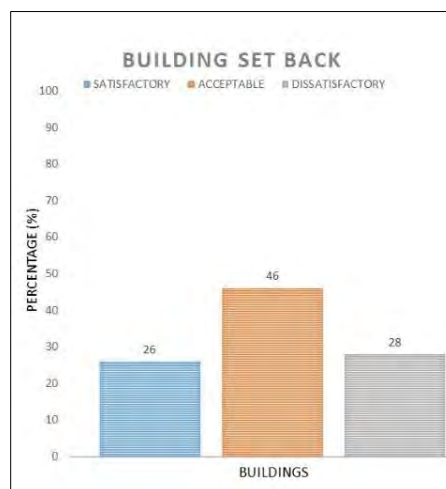


Figure 15. Building setback condition in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: The setbacks on every side of the building are maintained as per building code.
2. Acceptable: The setbacks on one or two sides of the building are used for parking or other non-roof functional purposes on the ground floor, which do not violate building code, but does not also fall under satisfactory level.
3. Dissatisfactory: The setbacks of the building violate the building code by not keeping required amount of setback space, the setback space is covered by temporary materials such as polythene and asbestos sheets, balconies and temporary stair are built on setback space.

26% of the buildings are found to be satisfactory, 46% acceptable and 28% dissatisfactory.

2. BUILDING CORE: The core of the building is its vertical circulation system which is the most vital element during any hazards as the residents are to escape from the building during an emergency through the building core (stair, lift, lobby). It is very necessary that the core is designed properly in order to manage any disastrous events. Therefore, the buildings are analyzed on few criteria regarding this topic such as position of the core inside the building, if the core is fire proof, have sufficient natural air and light in the core, presence of separate fire exits (where required).

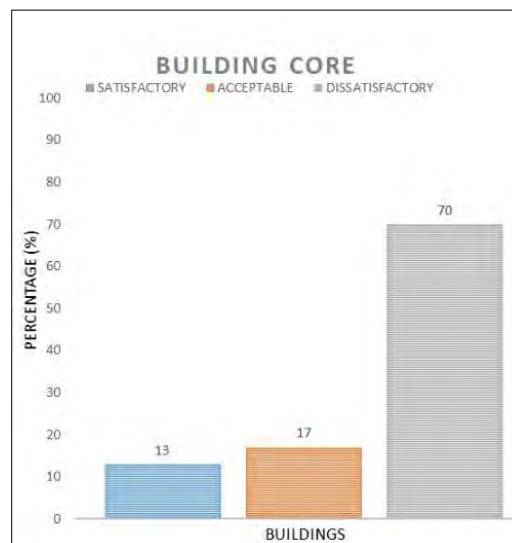


Figure 16. Design of building core in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: The plan of vertical circulation or the core of the building is fire proof, has provision of natural light and air, separate fire exits where required, strategically located to manage disaster.
2. Acceptable: The design of the building core is up to the building code guidelines but might lacks efficiency during emergency.
3. Dissatisfactory: The faulty design of the building core will create problems at the time of emergency, no natural light and air can pass through, lack of fire exits, fire markings.

13% of the buildings are found to be satisfactory, 17% acceptable and 70% dissatisfactory.

3. **INTERNAL LAYOUT OF BUILDINGS:** The internal layout of the building determines how sustainable the building is in terms of use of natural light and air. The privacy factor is also analyzed in these buildings along with the overall functional zoning which is very necessary for proper and efficient work flow inside the apartment. Also violations in building codes regarding this issue is also considered based on required room size.

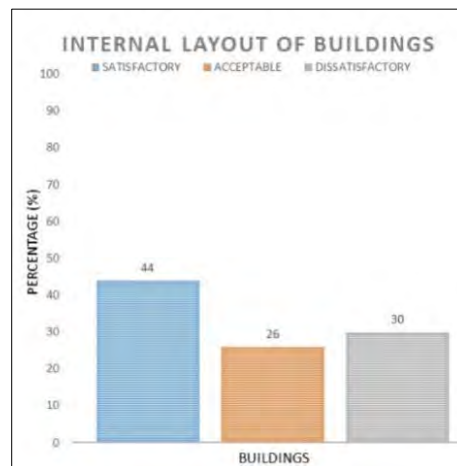


Figure17. Internal layout condition in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: The room size, provision of natural light and air, privacy with surrounding buildings/units, functional zoning are analyzed based on building codes and design principles.

2. Acceptable: The room size, functional zoning, etc. does not violate building code but not up to the standard.
3. Dissatisfactory: The room size is smaller than required, not enough or no ventilation and sunlight in some parts of the apartment, privacy is hampered, functional zoning is not up to the standard, no space for placing A.C. outdoor units.

44% of the buildings are found to be satisfactory, 26% acceptable and 30% dissatisfactory.

4. **BUILDING FAR/MGC:** The national building code has a ruling on Floor Area Ratio and Maximum Ground Coverage for every plot based on which the buildings need to be constructed. Violation in such codes imply unsustainable built environment. For example instead of constructing a five storey building with a ground coverage of X sqm which is in accordance with the building code, a eight storey building with a ground coverage of same X sqm (violating the code) will have impacts on overall energy or resource consumption, puts pressure on utility services, etc. Therefore, if practiced in mass scale then it will adverse effect on the whole neighborhood.

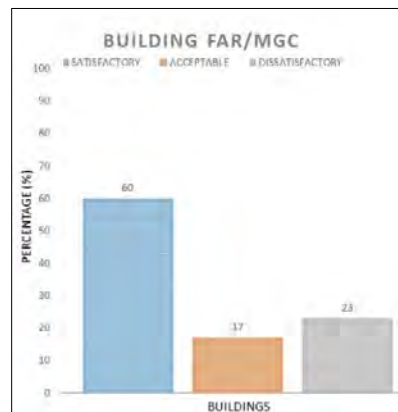


Figure 18. Building FAR/MGC verification on buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: Building height, total built-up area, maximum ground coverage, FAR does not violate building code.
2. Acceptable: The overall design does not violate building code but has

sacrificed area which could have been used as functional space.

3. Dissatisfactory: Area per floor is found to exceed than that of approved plan, maximum ground coverage exceeded, FAR incentive areas exceeded during construction.

60% of the buildings are found to be satisfactory, 17% acceptable and 23% dissatisfactory.

5. **FIRE SAFETY:** Fire safety is a vital issue in every aspect especially in multistorey residential apartment buildings due to higher number of occupants, different age group of people, different level of preparedness and response mechanism. A lot of lives and properties are at stake when fire incidents occur in residential buildings. Fire in a building can ignite from multiple sources for example electrical short circuit, after math of an earthquake leading to gas leakage and fire, burning of flammable elements, etc. Therefore, it is very necessary to plan the firefighting systems properly and effectively as many risks are there for the ignition of fire.



Figure 19. Fire safety in buildings constructed by renowned

The buildings are analyzed based on:

1. Satisfactory: Provision of firefighting elements such as fire extinguisher, hose reel, fire alarm, fire drills are conducted, presence of fire exits, most residents know how to operate an extinguisher.
2. Acceptable: Provision of fire extinguisher, fire exits, most residents do not know how to use extinguisher even though they know where it is located.

3. Dissatisfactory: Does not have any firefighting equipment, no fire drills conducted, lack of fire exits, the balconies are grilled for which during emergency people will be trapped inside if also cannot escape through fire exit.

10% of the buildings are found to be satisfactory, 30% acceptable and 60% dissatisfactory.

6. **SECURITY:** Security is a major concern for the apartment buyers. The residents feel secured when the building is kept under watchful eyes. Satisfaction arises when the building is installed with a few security appliances such as CC Cameras, intercom, burglar alarm system, etc. Any unpleasant occurrence can create psychological distress in residents. If the building is not properly secured then the chances of leaving the building unoccupied increases which can generate much economic loss.

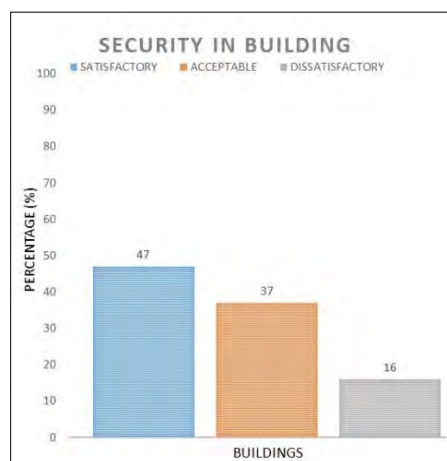


Figure 20. Security in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: The level of satisfaction is achieved through the presence of cc cameras, intercom, guard, sound building design.
2. Acceptable: The acceptable level is achieved through the presence of intercom and guard.
3. Dissatisfactory: Does not have cc cameras, guard is not always present at the main gate, the building design can create an opportunity for theft due to presence of accessible parking roof.

47% of the buildings are found to be satisfactory, 37% acceptable and 16% dissatisfactory.

7. **EXTERIOR TREATMENT:** Few exterior elements of the buildings are analyzed such as presence and location of shading device, condition of exterior wall paint, condition of planter boxes (if any). Good maintenance of the building implies healthy building or the building is performing well.

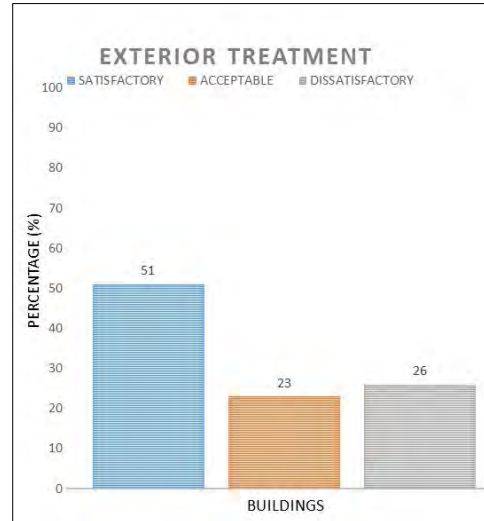


Figure 21. Exterior treatment condition in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: The condition of exterior façade paint, presence of shading device, condition of planter box is found to be satisfactory.
2. Acceptable: Proper placement of shading device, exterior wall paint or other treatment not satisfactory since not painted or maintained regularly up to the standard.
3. Dissatisfactory: Exterior wall paint or other treatments not maintained, lacks shading device in some openings of the building, planter box are not trimmed or maintained.

51% of the buildings are found to be satisfactory, 23% acceptable and 26% dissatisfactory.

8. **COMMUNITY FACILITIES:** In a multistorey residential apartment building it is very necessary to provide few community facilities such as community room, office room, prayer room, and children play area, etc. for the better development of the community. These spaces usually act as interactive spaces which tend to enhance the bonding between the different

families residing in the same building through effective communication and understanding among each other. Also at the time of crisis or emergency the different families can help each other and act as the first responders when they are connected or well aware of each other. Therefore, the buildings are analyzed on few criteria to understand how well the developers are willing to create such interactive spaces for their customers.

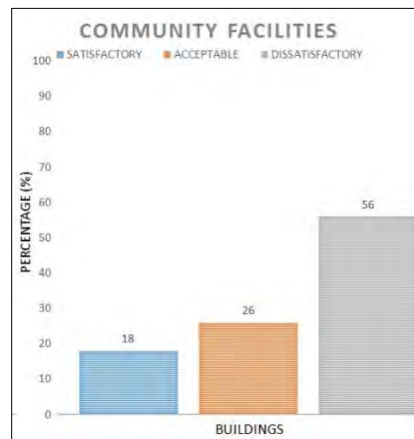


Figure 22. Provision of community facilities in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: Satisfactory level is achieved by the provision of community room, games room, gymnasium, prayer room, office room, children play area, care taker room, driver’s waiting space.
2. Acceptable: Provision of community room, care taker room, driver’s waiting space are provided to an acceptable level.
3. Dissatisfactory: No community facilities are provided except for driver’s waiting space which is not up to standard and care taker’s room.

18% of the buildings are found to be satisfactory, 26% acceptable and 56% dissatisfactory.

9. **PARKING:** Many issues are associated with the parking criteria such as total number of car parking spaces with respect to total number of apartment units in each building, slope ratio of ramp, parking grid as per building code, basement parking, etc. Even though the required number of car parking does not need to be equal to the number of apartment units in a building as per building code, but for convenience and buyers demand each apartment unit

should have at least one car parking space. Therefore, this topic seeks to find out the parking condition in these buildings. Since Dhaka city does not have public car parking lots and also the roads are not designed to park on the roads so it becomes mandatory to park the private cars in their own property. Therefore, any failure to provide sufficient car parking in each building will create problems for its surrounding buildings for which the car parking conditions for the residential buildings need to be analyzed.



Figure 23. Parking condition in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: Satisfactory level is achieved by the provision of required number of car parking space with respect to number of apartments in the building, slope of ramp and parking grid as per building code.
2. Acceptable: Provision of required number of car parks is justified by building code but lacks with respect to number of apartments in the building is acceptable.
3. Dissatisfactory: Not enough car parking space, shared parking space create feasibility problems, slope of ramp and parking grid are violated.

57% of the buildings are found to be satisfactory, 16% acceptable and 27% dissatisfactory.

10. SUSTAINABILITY: Many experts claim that the built form of Dhaka city is not taking a sustainable solution. For which it has become a vital issue to

understand how sustainable are the buildings constructed by the renowned developer companies. The sustainable issues of the building are alternative energy source such as solar panel, rooftop garden, building orientation and so on.

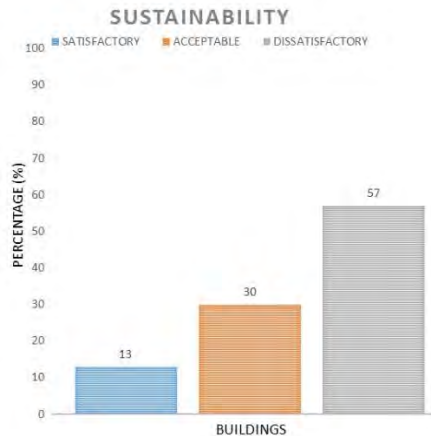


Figure 24. Sustainability issues in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: Provision of solar panel, rooftop garden, planter box on all or some floors, 10” thick exterior wall, building orientation, operable windows have been found to be satisfactory.
2. Acceptable: Provision of planter box on every or alternate floors, building orientation, operable windows, some provision of solar panel is acceptable.
3. Dissatisfactory: No provision of solar panel, rooftop garden, planter box on apartment floors, 5” thick exterior wall, building orientation is not satisfactory. 13% of the buildings are found to be satisfactory, 30% acceptable and 57% dissatisfactory.

11. **DISASTER PREPAREDNESS:** In recent time, the citizens of Dhaka city have witnessed minor shaking of the earth and fire incidents in apartment buildings. This topic focuses on the level of disaster preparedness of the residents of residential apartment buildings as much risk lies within their buildings in terms of inhabitants and valuable assets. Their awareness and level of preparedness can determine the risk factors, minimize the risks, and to manage the threats more effectively.

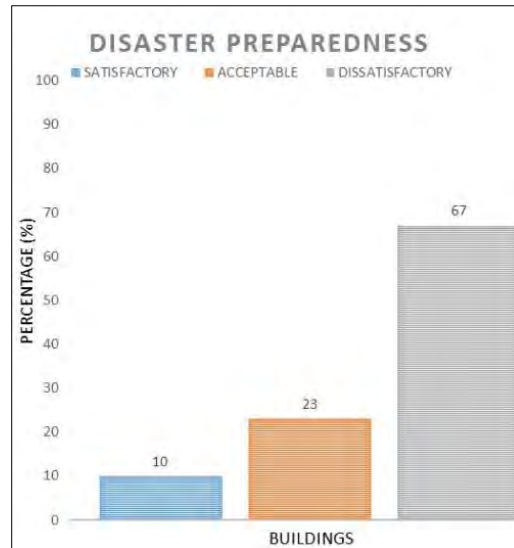


Figure 25. Disaster preparedness of residents in buildings constructed by renowned Real Estate Developers.

The buildings are analyzed based on:

1. Satisfactory: Fire drills conducted one or two times, residents are aware of the possible disasters and are prepared to some extent.
2. Acceptable: The residents are aware of the possible disasters but have never experienced any sort of emergency drills, few residents have some knowledge of what to do during emergency.
3. Dissatisfactory: No fire or earthquake drills, the residents are unaware of the possible hazards and are highly unprepared.

10% of the buildings are found to be satisfactory, 23% acceptable and 67% dissatisfactory.

3.2.3 SURVEY DATA ANALYSIS OF REAL ESTATE DEVELOPERS VIEW ON SUSTAINABILITY AND DISASTER MANAGEMENT ISSUES

After receiving some thoughts about the expectations, needs and problems faced by the residents of apartment buildings constructed by different Real Estate Developer companies, and from the knowledge gained through literature review it was necessary to seek the opinions of the developer companies on some issues that are brought forward by the user group and the experts about their awareness on designing sustainable buildings, and how they plan to reduce disaster risks in their buildings and surroundings. The issues discussed with the six Real Estate Developer companies are:

1. **SOCIAL INTERACTION:** Enhanced social interaction among the residents of the apartment building can create many solutions such as in case of security, disaster awareness and preparedness, strong community buildup and so on. Therefore, more interactive spaces are needed to achieve effective social interaction among the residents.

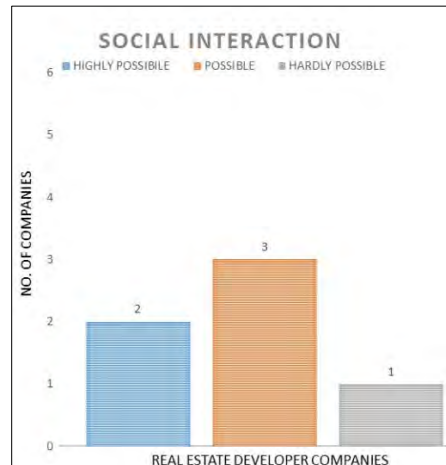


Figure 26. Real Estate Developer’s view on enhancing social interaction in their buildings.

The companies are inquired about the possibilities of achieving interactive spaces within the building:

HIGHLY POSSIBLE: 2 out of six companies commented there is a high possibility of achieving social interaction among the residents of the respective building through provision of more interactive spaces such as leaving more open (green) spaces on the ground, more interactive roof tops, designing interactive balconies and lobbies.

POSSIBLE: 3 out of six companies commented that it is possible to achieve more interactive roof tops and interactive balconies.

HARDLY POSSIBLE: 1 out of six companies commented that it is hardly possible to provide other functions other than more interactive rooftops.

2. **SUSTAINABILITY:** Sustainability issues in a building such as use of solar panels, rainwater harvest, proper building orientation, use of 10” thick exterior wall, rooftop garden are discussed with the developer companies.

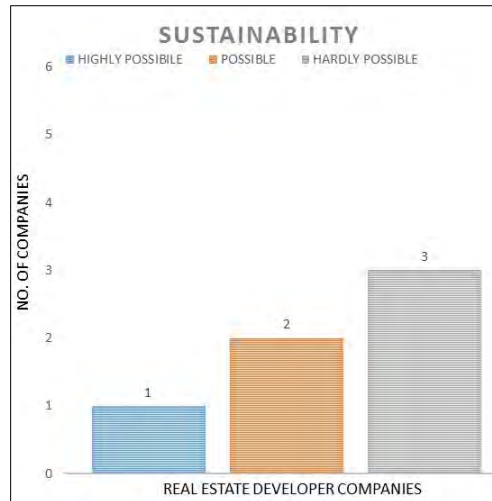


Figure 27. Real Estate Developer’s view on achieving sustainability In their buildings.

The companies are inquired based on the following criteria:

HIGHLY POSSIBLE: 1 out of six companies commented that it is highly possible to apply sustainable solutions such as rainwater harvest, more use of solar panel, east-west elongated building orientation, 10” thick outer wall, rooftop garden, vertical greenery.

POSSIBLE: 2 out of six companies commented that it is possible to use solar panel, 10” thick outer wall, and vertical greenery in their buildings.

HARDLY POSSIBLE: 3 out of six companies commented that except for vertical greenery other solutions can hardly be achieved in their building design.

3. **CAR PARKING:** A new concept, in our context, of car parking solution, neighborhood car parking tower, has been brought forward to the developer companies to seek their knowledge about the feasibility, possibility and acceptance by the apartment buyers if applied in neighborhood scale in every residential areas of Dhaka city.



Figure 28. Real Estate Developer’s view on constructing car parking towers.

The companies are inquired about the commencement and construction of neighborhood parking towers instead providing parking facilities for individual buildings.

None of the companies thought that it can be highly possible, 2 out of six said it is possible and 4 out of six said it is hardly possible.

- 4. DISASTER RISK REDUCTION:** The developer companies can play a vital role in community-based disaster risk reduction program in which they can make aware and involve the apartment buyers and the tenants of their buildings about the disasters. Since the developer companies have more knowledge and access to public service providers, the governance issue can be more systematic if organized and managed by the developer companies for their respective clients. Therefore, it is necessary to understand how willing are the developer companies in disaster risk reduction by community- based approach.

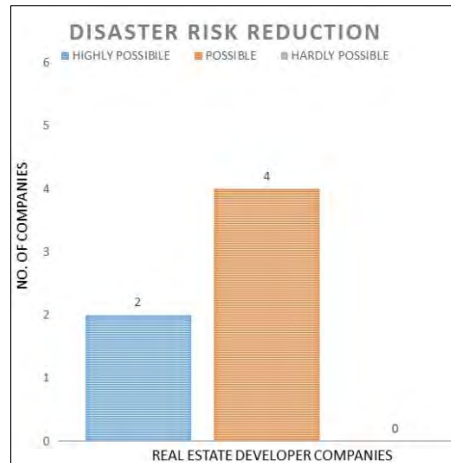


Figure 29. Real Estate Developer’s view on disaster risk reduction in their buildings.

The companies are inquired based on the following criteria:

HIGHLY POSSIBLE: 2 out of six companies commented that it is highly possible to apply community-based disaster risk reduction, fire and earthquake drills, awareness buildup among the residents, provision of necessary training with the help of BFSCDA, provision of firefighting system inside building.

POSSIBLE: 4 out of six companies commented that it is possible to provide firefighting system inside their buildings and conduct fire and earthquake drills arranged by the company.

HARDLY POSSIBLE: No companies felt that they will be incapable of reducing the disaster risks in their buildings for their clients.

- 5. SLUM UPGRADATION:** Slum areas in Dhaka city are responsible for the degradation of the environment to some extent. So to improve the environmental conditions one way is to improve the conditions of the slum people. Therefore, another issue has been addressed in front of developer companies which is slum upgradation which mainly focuses in the employment and providing habitation for one or two families from the slum with proper training for engaging them in various activities in their buildings.

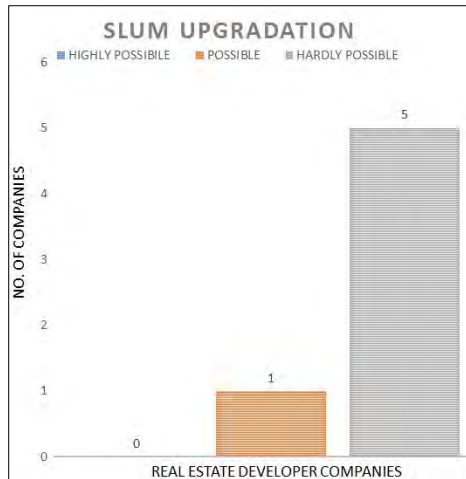


Figure 30. Real Estate Developer’s view on slum upgradation through their buildings.

The companies are inquired if some sort of employment and living space could be provided to one or two families from the slum area in each building in the same way the living spaces are provided to the drivers and care taker of the building and in return these group of people could assist in the various household activities and the overall maintenance of the building:

None of the developer companies thought this can be highly possible, 1 out of six said it is possible and 5 out of six said it is hardly possible.

Chapter 4
RESULTS AND ANALYSIS

4.1 RESEARCH FINDINGS

4.1.1 RESEARCH FINDINGS ON ANALYSIS OF HOUSEHOLDS IN APARTMENT BUILDINGS

- 60% of the households have suggested the need of community facilities such as community room, office room, care taker's and driver's waiting space.
- 50% of the households have suggested the need of security by the installation of cc cameras throughout the building, intercom, and burglar alarm system, grilled openings besides having a full time security guard.
- 70% of the households have no firefighting system in their buildings and suggested the need of firefighting equipment such as fire extinguisher, hose reel, fire alarm system, sprinkler system in lobby, fire markings, and fire drills.
- 56% of the households have privacy problems with the neighboring buildings.
- 66% of the households feel the need for breathing space such as non-grilled balconies, planter box in balconies, green rooftop, and well ventilated interior.
- 50% of the households feel that they have no parking problems and parking towers will not be feasible for them.
- 84% of the households feel that solar panels are very necessary and should be used more.
- 46% of the households feel that harvesting rainwater collected from the rooftop might be useful to reduce the water consumption from WASA.
- 50% of the households have problems in functional zoning, privacy between public and private zones inside an apartment, natural air and light, utility functions in their apartments
- 56% of the households feel that rooftop garden might reduce heat, can create a sense of living close to ground, can bear maintenance cost, and adds beauty to the building.
- 54% of the households said that they might have faced water-logging problems in their neighborhood.

- 66% of the households feel that kitchen waste disposal using the 3R's system: Reuse, Reduce and Recycle might be a good solution for a clean and systematic way of waste disposal and might follow it if provided with proper and sufficient knowledge.
- 60% of the households are unprepared and unaware of possible hazards in their apartments.
- 56% of the households feel that earthquake and fire drills will be useful, knowledge about fire exits and use of fire extinguishers can be very helpful, contacting BFSCDA during emergency should be the wisest thing to do.

4.1.2 RESEARCH FINDINGS ON ANALYSIS OF BUILDINGS CONSTRUCTED BY SELECTIVE REAL ESTATE DEVELOPER COMPANIES

- 46% of the buildings have acceptable building setbacks on one or two sides of the building which are used for parking or other non-roof functional purposes on the ground floor, which do not violate building code, but does not also fall under satisfactory level as these cover up the rain water soak able areas in the plot.
- 70% of the buildings have dissatisfactory building core which will create problems at the time of emergency, no natural light and air can pass through, lack of fire exits and fire markings.
- 44% of the buildings have satisfactory internal layout of buildings in case of room size, provision of natural light and air, privacy with surrounding buildings/units, functional zoning are analyzed based on building codes and design principles.
- 60% of the buildings have satisfactory building FAR/MGC regarding building height, total built-up area, maximum ground coverage, FAR does not violate building code.
- 60% of the buildings have dissatisfactory fire safety systems: does not have any firefighting equipment, no fire drills conducted, lack of fire exits, the balconies are grilled for which during emergency people will be trapped inside.
- 47% of the buildings are equipped with cc cameras, intercom, guard, at a satisfactory security level.
- 51% of the buildings have satisfactory exterior treatment such as the condition of exterior façade is well painted, presence of shading device in strategic positions, maintenance of planter box is up to satisfactory level.

-56% of the buildings have dissatisfactory provision of community facilities: no community room or office room, not properly designed driver's waiting and the care taker's room is too small for habitation.

- 57% of the buildings have satisfactory parking facilities with provision of required number of car parking space with respect to number of apartments in the building, slope of ramp and parking grid as per building code.

-57% of the buildings have dissatisfactory sustainability pattern with no provision of solar panel, rooftop garden, planter box on apartment floors, 5" thick exterior wall, building orientation is also not satisfactory.

- 67% of the buildings have dissatisfactory level of disaster preparedness in their buildings with no fire or earthquake drills, the residents are unaware of the possible hazards and are highly unprepared.

4.1.3 RESEARCH FINDINGS ON ANALYSIS OF REAL ESTATE DEVELOPERS VIEW ON SUSTAINABILITY AND DISASTER MANAGEMENT ISSUES

-50% of the companies have said that more interactive roof tops activities and balconies can be provided for better social interaction among the residents and provision of more interactive spaces such as leaving more open (green) spaces on the ground, lobbies, etc. may not be possible to achieve in their buildings.

- 50% of the companies feel that sustainable issues such as rainwater harvest, more use of solar panel, east-west elongated building orientation, 10" thick outer wall, rooftop garden are hardly possible to incorporate these in their building designs except for vertical plantation.

-66.67% of the companies feel that introduction and construction of neighborhood parking towers instead providing parking facilities for individual buildings can hardly be achieved.

- 66.67% of the companies feel that provision of firefighting system inside building, fire and earthquake drills can be possible to achieve more than community-based disaster risk reduction, awareness buildup among the residents, provision of necessary training with the help of BFSCDA.

-83.33% of the companies feel that the provision of some sort of employment and living space can hardly be provided to one or two families from the slum area in each building for slum upgradation.

4.2 ANALYSIS OF RESEARCH FINDINGS

4.2.1 ANALYSIS ON VIEWS OF APARTMENT RESIDENTS AND BUILDINGS DESIGNED BY RENOWNED REAL ESTATE DEVELOPERS ON FUNCTIONAL ASPECTS

-Even the most renowned Real Estate Developer companies practicing in Dhaka city are found to have compromised their building design in many ways. The most important part of the building is its core, which is found to be not functional at the time of fire emergency due to its design fault.

-50% of the household respondents have problems in the internal layout of their apartment design such as the interior planning of the apartment units are not very well solved since privacy among public and private zones inside the apartment is overlooked and privacy with neighboring unit and other buildings are not considered properly. In few cases the interior of the apartments is found to use artificial lighting at day time as enough light cannot enter the apartment due to lack of openings and less gap between the two units for ventilation and sunlight. 44% of the buildings constructed by renowned developers have a satisfactory internal layout. This proves that the renowned developers are more attentive to design compared to other less experienced developers.

-50% of the household respondents commented that they do not have any car parking problems and finds car parking tower will not be feasible for them. 57% of the buildings constructed by the renowned developers have satisfactory car parking facilities. 4 out of 6 selected developer respondents said it is hardly possible to implement car parking towers in the neighbourhood.

-50% of the household respondents felt the need of CC cameras, intercom, standby security guard, burglar alarm system and grilled openings. 47% of the buildings constructed by renowned developers are found to have installed CC cameras, intercom, and guard in their buildings. This implies that the renowned developers are in aware of their client's needs.

-The residents of the apartment buildings seek for more interactive community spaces, which are not being fulfilled up to their expectations. 60% of the household respondents have expressed the need of community facilities such as community room

and office room in their building whereas, 26% of the buildings constructed by renowned developers contain community room and office room in their buildings.

-The setback of the buildings constructed by the renowned developers are highly maintained according to the building codes as well as building FAR/MGC has been found to be satisfactory. The exterior treatment of these buildings are satisfactory as well.

-3 out of 6 renowned developer respondents feel it is possible to provide more interactive spaces in their buildings such as more interactive rooftops and balconies.

4.2.2 ANALYSIS ON VIEWS OF APARTMENT RESIDENTS AND BUILDINGS DESIGNED BY RENOWNED REAL ESTATE DEVELOPERS ON DISASTER MANAGEMENT

It is found during survey that household respondents do not know how to use the alternative stairway to exit and some are totally unknown about it. In some cases alternative stairways are not spacious enough to get off all residents quickly during earthquake. Firefighting system such as fire extinguisher, hose reel, etc. exists in building but dwellers are unaware of its usage. 67% of the apartment building respondents have no mental preparedness and precaution against fire accidents. 60% of the household respondents are found to be unaware of any hazards that can arise while residing in an apartment building. Most of them lack training in handling fire accidents. 70% of the household respondents felt the need of firefighting system in their building such as fire extinguisher, hose reel, fire alarm system, and sprinkler system in lobby areas, fire markings and fire drills. Whereas, 60% of the buildings constructed by the renowned developers lack such firefighting systems in their buildings. This shows that the apartment residents are more aware of fire accidents but the current practices of developer companies are found to care less about fire accidents in their buildings. 58% of the household respondents have shown interest in disaster risk reduction such as earthquake and fire drills, and 4 out of 6 renowned developer companies have shown interest in installing firefighting system and conduct fire and earthquake drills in their respective buildings. This shows that the renowned developer companies are more willing to manage disasters in an effective way compared to other less experienced developers.

4.2.3 ANALYSIS ON VIEWS OF APARTMENT RESIDENTS AND BUILDINGS DESIGNED BY RENOWNED REAL ESTATE DEVELOPERS ON SUSTAINABILITY

Very few buildings are found to have consider sustainable building design solutions. But the residents are highly interested to implement sustainable solutions in their buildings such as rainwater harvest, solar panel, green roof etc. but the developer companies are found to be less concerned about sustainability issues in buildings. 84%, 46% and 56% of the household respondents felt the need of solar panel, rainwater harvest system and rooftop garden in their buildings respectively. 57% of the buildings constructed by the renowned developers lacks such and many other sustainable issues in their buildings. 3 out of 6 renowned developer respondent feel it can be hardly possible to provide rooftop garden, rainwater harvesting system, more use of solar panel, etc. in their buildings.

Chapter 5

RECOMMENDATIONS AND CONCLUSION

5.1 RECOMMENDATIONS FOR REAL ESTATE DEVELOPER COMPANIES FOR ATTAINING SUSTAINABLE APPROACH IN BUILDING DESIGN

Policies and building code and regulations are considered as much as possible to suggest new design concepts to tackle the problems arising from living in the apartments and recommendations have been written down. Knowledge gained from literature review, mainly focusing those issues which are not directly covered during the survey, are also considered for recommendations for future development in housing sector in Dhaka city. Furthermore few of the proposals are discussed with the Real Estate Developer companies to understand their perspectives on the possibility of implementing these proposals and associated problems or challenges that can arise from the implementation of these proposals.

5.1.1 PROPOSALS TO ATTAIN SUSTAINABILITY IN RESIDENTIAL BUILDINGS OF DHAKA CITY

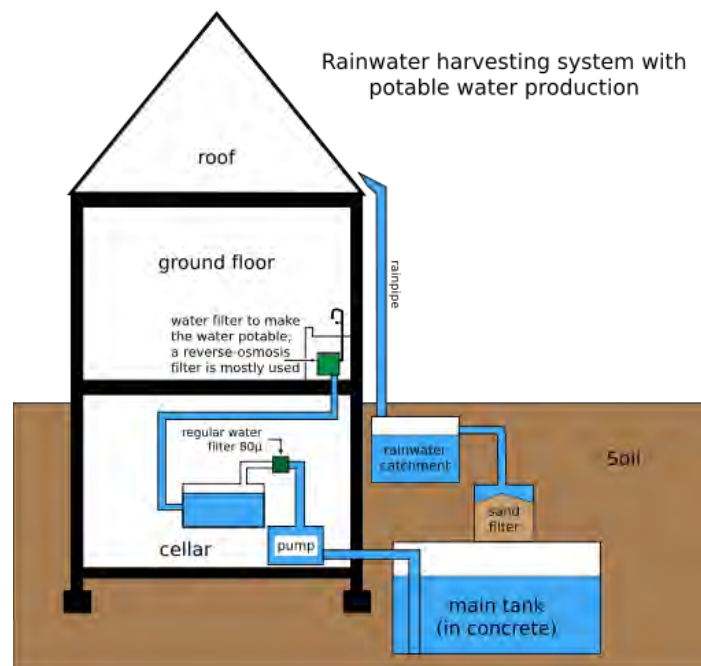
Sustainable construction is a way for the building industry to move towards achieving sustainable development, taking into account the environmental, socio-economic and cultural issues such as design and management of buildings, materials and building performance, energy and resource consumption. Smart and sustainable buildings characterize good exercise in scheming, planning and building structures to make them more publicly, environmentally and profitably sustainable. All developments should be preceded by a detailed environmental impact study in order to achieve a sustainable urban development of Dhaka city. If due to global warming, sea levels actually rise by even a few feet the sustainability of most of the urban centers in Bangladesh will be seriously threatened. In such a situation sustainability of urban housing will be an extremely difficult concept unless new building materials are innovated and new technology is introduced.

a. RAINWATER HARVEST

It is found that the total water demand in Dhaka city is 2,240 million liters per day whereas supply is

2,150. About 87 percent of this supply comes from groundwater resources and the remaining 13 percent from surface water. For the huge extraction from the underground water source, the ground water table is declining day by day. It has been found that the current groundwater depletion rate is 3.52 meter per year.

Concept of rainwater harvesting:



Source: Internet

Fig: Rainwater harvesting system in a building

Rainwater is a free source of nearly pure water and rainwater harvesting refers to the collection and storage of rainwater and other activities aimed at harvesting surface and ground water. It also includes the prevention of loss through evaporation and seepage and all other hydrological and engineering interventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a watershed.

If rainwater can be collected from every roof top of the residential buildings in Dhaka city and further used in household activities, then the pressure of supplying immense amount of water by WASA can be reduced significantly. Dependency on public utility services can be reduced and thus other issues such as alarming ground water depletion can also be rectified.

None of the surveyed buildings have rainwater harvesting system in it which shows that all the buildings are highly dependent on WASA for meeting its water demand. 1 out of six developer companies are interested to harvest rainwater in their specific and exclusive residential projects.

b. ROOFTOP GARDEN

A rooftop garden is a garden on the roof of a building. Besides the decorative benefit, roof plantings may provide food, temperature control, hydrological benefits, architectural enhancement, habitats or corridors for wildlife, recreational opportunities, and in large scale it may even have ecological benefits. For Dhaka city, this could be an alternative solution to tackle the heat island issues generating in the city. As the built up areas of Dhaka city has already created much damage to the environment such as lack of greenery and too much built form has created heat island scenario in few parts of Dhaka city, so this concept can help create a microclimate suitable for habitation. Apart from heat trapping by the plants, it can also help in solving dust pollutions in the city making the air more fresh and healthy. As there is shortage of recreational parks in the different neighborhoods therefore, this can be a positive solution for those who have little or no access to parks in the city. The desire of living close to the ground, while living in high-rise residential buildings, can also be achieved through rooftop gardens. Social interaction and mental health of the residents will be improved. Therefore, this is a good solution for healthy living in an apartment for all age groups of people.

Few of the surveyed buildings are found to have practicing rooftop gardening which a positive initiative is being taken by few developer companies. More companies need to practice this. The residents are more interested to have spaces like this but the developer companies are more concerned about the cost in making such rooftops. Also few residents have shown concern regarding maintenance cost that might be beyond their affordability range.

c. SOLAR PANEL

The choice of cooling, solar and ventilation system, for example, has a direct impact on a buildings energy efficiency and conservation potential. Few developer companies are found to have installed solar panels in their buildings. The residents are aware of the benefits of solar panels. Since the initial cost of solar panel is very high

for which limited panels are installed in the buildings. More and more usage of solar panels will only make the energy consumption situation better in the long run.

d. MISCELLANEOUS

- a. Many buildings are constructed in north-south orientation rather than east-west for which the maximum length of the building facades are faced towards east-west directions, thus receiving maximum amount of heat. The buildings should be east-west elongated.
- b. Almost all the surveyed buildings are found to have 5” thick exterior brick walls for which heat can easily penetrate through the walls into the interior. The exterior walls should be 10”thick brick walls.
- c. Many buildings are found to have openings on the west side of the buildings without any louvre or sun heat cutting device for which the building traps all the heat from the west. No openings should be provided on the west façade of the building without shading device.

5.1.2 RETHINKING ARCHITECTURAL DESIGN PRACTICES

An important aspect of urban housing design is the extent to which the housing can accommodate user needs, climatic conditions and local natural hazards, such as earthquakes, floods and storms. The settlement plan for the neighborhood should address prevailing natural hazards and local climate conditions. A housing design should increase resilience according to the hazard to which it is exposed. For example, in earthquake prone areas, buildings with open floors or irregular shapes are typically more likely to fail with the incidence of earthquake.

Positioning of windows can also maintain certain degree of privacy. Screening by plantation and iron fence rather than solid high wall can increase visibility and security of the neighborhood. Plot consolidation of the adjacent plots could create ample space for plantation- plants allow air circulation, protect dwellers from heat. Vegetation is important to improve air quality in a city. The vertical circulation or the core of the building should be designed in such a way that during fire accidents the residents do not pass through lift lobbies. The lift lobby should be controlled and the fire stair or regular stair should not open in the lift lobby. Fire hose or location of the fire extinguishers should be allocated in the building plan. Place the generators underground to minimize sound pollution. Cluster buildings in a staggered pattern to

allow proper ventilation. The shape of the building has an important effect on its stability which are:

- a. The more the compact the building's shape, the better its stability.
- b. L-shaped plans are unstable. An alternative is to separate house parts from each other.
- c. For better resistance to floods, consider elevating the ground floor and building an extra floor or using a flat roof that residents could flee to, if necessary.
- d. To accommodate the local climate, research the climate zone.

A number of steps can be taken to increase the natural air flow:

- a. The building's shape should be "open" character, allowing air to flow through openings, such as windows, louvres and doors. Openings should be placed on opposite side of the buildings to improve cross-ventilation. However, the openings should be well distributed to ensure earthquake resistance.
- b. When possible, the buildings should be placed with their longer sides to the prevailing wind direction in order to maximize airflow.

It is essential to ensure that the shape, form and size of the housing complies with the national building codes and other laws and regulations, particularly with respect to anti-seismic, storm and flood specification. In housing design, favor solutions that are environmentally sustainable and energy efficient, use housing designs that are resistant to natural hazards, such as earthquakes, floods and storms, incorporate the users' needs and cultural requirements.

Building Code: Building codes should be based upon identified hazard risk, and are normally established upon a minimum standard of safety. Building codes that do not appropriately address hazard and risk induce high risks into the housing design. Codes must be regularly updated to follow up industrial innovations, new expertise, and new practices and knowledge of the construction business. Building codes are ineffective if they are not properly enforced.

In recent earthquakes, buildings have acted as weapons of mass destruction. So Bangladesh National Building Code (BNBC) should be updated keeping earthquake hazard in mind.

5.1.3 DISASTER MITIGATION THROUGH CAR PARKING TOWERS

Urbanization disrupts natural drainage patterns, natural water courses are destroyed, natural retention run off by plants and soil is removed and the creation of impervious surfaces increases the amount of runoff. This runoff becomes polluted as solid waste, silt and contaminants are washed off roads, leading to water-logging and creating adverse social, physical, economical as well as environmental impacts. In order to save Dhaka from the miseries of water-logging, indiscriminate closure of natural drainage channels and low-lying areas should be stopped immediately.

When the rain falls on to undeveloped land, most of the water will soak into the topsoil and slowly flow through the soil to the nearest watercourse or groundwater. A small portion of the rainfall, 15% to 20%, becomes direct surface run off that usually drains into water courses slowly because the ground surface is rough. On the other hand, when the catchments are developed, the proportion of the land covered by impervious surface (road, parking areas, roofs, driveways and pavements), will increase, preventing the natural infiltration of rainfall into the ground. Often the remaining open ground cannot accept water as rapidly as it did in its natural state, because during construction topsoil is removed, compacted or mixed with low permeability subsoil. The flow rates in the receiving water are therefore much more sensitive to rainfall intensity and volume than those in undeveloped catchments and result in water-logging in the city.

It is found during survey that the ground floors of the residential apartment buildings are mostly used in car parking, keeping generator, driver's waiting area, care taker's room with kitchen and toilet, community or office rooms for bigger plots, electromechanical room, etc. Since car parking takes up the maximum space in the ground floor compared to other functions, therefore, neighborhood car parking towers can help to free the ground floors of the building for more water catchment area. More soak able land area will be available so the problems arising due to the built-up areas (i.e. water-logging) can be reduced as the rainwater can penetrate into the soil more than current situation. When more water seeps back into the soil, there is a high chance that the ground water level can be increased as less pervious area will be available to stop rainwater from seeping into the soil. When every building in the neighborhood shifts to neighborhood car parking towers much soak able land will

emerge. More green spaces will be produced on individual plots which can be used for vegetation, children play area, etc. As the cars mobilization will be reduced within the neighborhood, so the neighborhood will have far less sound, dust and noise pollution. The roads can only be used for rickshaws, bicycles, ambulance, fire brigades. A much safer and healthy environment can be achieved through this. A detail analysis on this hypothesis is required before it can be suggested for implementation enforced by national building code.

5.1.4 COMMUNITY-BASED DISASTER RISK REDUCTION APPROACH

Awareness and subsequent preparedness in community and household level reduce the primary, secondary hazard of earthquake as well as injury, casualty and property damage. The Community Based Disaster Risk Management can prepare the citizens at community level. This kind of initiative can make the people realize the importance of following the building code and soil testing during construction of buildings, need to act accordingly to their contingency plan in order to respond effectively in time of an earthquake emergency and how to react and handle fire accidents. Also they will understand the importance to cope with a disaster and realize that they have a responsibility towards making their community safe. Mock drill is very effective for raising awareness as well as capacity enhancement especially in the field of disaster preparedness and response. It is also an effective way of learning with entertainment. To strengthen the process of earthquake risk management in Dhaka is an urgent need for:

- a. Integration of disaster management in city planning
- b. Massive public awareness
- c. Monitor and ensure enforcement of building codes and soil testing
- d. Training on first aid and search and rescue for community people.

A well-coordinated emergency response to an earthquake is likely to save many lives and prevent earthquake induced hazards escalating the magnitude of the disaster. Community organizations can promote participation in emergency preparedness activities and help organize practice drills and exercises to raise awareness and ensure that everyone knows what to do. A community disaster plan can also be drawn up. Involving firefighting, search and rescue, first aid, making contact with authorities, supervision of food, water and power provisions. Pre earthquake emergency planning

is one of the best ways to ensure that the earthquake disaster can be handled effectively. Post-earthquake quick damage inspection of buildings is the first essential step immediately after a major earthquake disaster to mitigate the secondary disaster caused by aftershocks. The result of quick inspection also provides the basic information to estimate the number of temporary houses and refuge centers required for the displaced people.

Public awareness and training on fire hazards can have the following effects:

- a. Awareness at the individual public level could prevent the occurrence of fire incidence.
- b. In most buildings, firefighting equipment are located in insulated places and people are unaware of it.
- c. Training is an important consideration that can reduce the loss of lives and damage of properties.

The underlined aspects should be considered seriously for fire safety in the city are:

- a. Preserve natural water bodies
- b. Widen the narrow roads
- c. Proper land use zoning- no non-residential functions in residential areas. Setback rules and FAR should be enforced strictly.
- d. Risky areas should be demarcated
- e. Provision of street fire hydrants

Real Estate Developer companies should take the initiative in organizing community-based disaster risk reduction campaign in each of their residential buildings. As they already have the necessary information of their clients which can provide sufficient information to BFSCDA while managing disasters so a keen relationship should be maintained among the developer companies and BFSCDA. They should conduct mock drills with the help of BFSCDA, provide necessary training to the residents in an organized way. Every building should have a fire control room and an operator who should be trained by the developer company. Emergency contact number of BFSCDA should be displayed on billboards in the common areas of the building such as lift and stair lobbies on each floor. Urban fire hazard management is not only an institutional issue, rather it is much more of a planning issue. Fire safety issues should be addressed from the individual building premises to the city planning level.

5.1.5 SLUM UPGRADATION THROUGH EMPLOYMENT AND HABITATION IN RESIDENTIAL BUILDING

Informal settlements tend to grow on hazardous land without access to basic services and infrastructures or the benefit of disaster risk reduction planning. The social network among families and within neighborhoods is usually very important for the sustainable development of communities, including poverty reduction. There are valid fears that in near future Dhaka could be mega polis due to unplanned growth of slums or shanty towns. Economic damage of slum dwellers will be more because they depend on the people who live in the buildings. So there should be introduced plan for slum community. One solution could be rehabilitation of one or two slum oriented families in each residential building and providing them with employment within the building by the residents such as to work as housemaids, guard, sweeper, etc. The Real Estate Developer companies can help train the slum oriented people for a better and healthy living which will ultimately work in favor to sustainable environment and social cohesion.

5.1.6 MISCELLANEOUS RECOMMENDATIONS

-All planning activities should be directed towards developing livable urban environment with special focus on:

- a. Creating compact complete communities by mixing land uses and using land more efficiently. Compact, mixed-use development allow non-motorized transportation- walking and bicycling and transit to work more effectively.
- b. Creating inclusive neighborhoods by ensuring that a diversity of housing types are accessible to a wide range of people of different age groups, family types and income. Special attention should be given to the needs of low-income groups.
- c. Calling the needs of children as much priority as the needs of people of other ages in transport and land use planning. Creation of child-friendly cities and towns is a necessity.
- d. Ensure that people of all age and income groups including those with disabilities will have full access to public facilities and services and incorporating green infrastructure into communities.

-In order to ensure safety of life, old and potentially dangerous dilapidated buildings should be identified and demolished, if economic renovations are not possible. The Real Estate Developer companies should come forward to make the city sustain by choosing moral values over business policies. That is, they should try to develop the potentially hazardous buildings without thinking about monetary return out of it.

-The government should strictly implement building codes as well as identify and retrofit the vulnerable buildings. The government should retrofit all public buildings and can offer soft loan to the people so they can retrofit their old buildings.

-Provision of sprinkler protection should be ensured in each high-rise building for firefighting. Every high-rise building should have obligatory fire evacuation plan.

The Fire Protection Act, 2003 has drawn out some guidelines to mitigate fire incidents in buildings which are as follows:

- a. The buildings which are of six stories and above must have an emergency exit, elevator and emergency electricity supply.
- b. Every high-rise must have an individual control room and gas and heat detection system.
- c. Every high-rise must have trained employees to operate the equipment in case of fire occurrence.

-The developer companies which are intentionally filling up the wetlands due to lack of governance should not be involved in such activities solely for protecting Dhaka city from further natural and manmade hazards.

-Existing narrow road system in many cases is obstructing the entrance, movement and maneuver of fire service at the time of emergency. Low mobility on the road system also increases the response time. The government should take necessary steps to widen up the roads. Now a days it is found that the new buildings have left out the space for road widening but the surrounding buildings which are not yet developed as per current building codes have narrow roads in front of them. As a result, fire brigades do not get sufficient space to pass through. The developer companies in this regard should take more responsibilities on its shoulder by trying to convince the surrounding buildings to undergo development.

-Many canals and lakes have been subject to encroachment and filled up for

construction of buildings for which the fire fighters face scarcity of water during firefighting. The city also has no street fire hydrant arrangement. Therefore, the developer companies need to be extra cautious about firefighting systems in their buildings.

-The authority does not have any database or sufficient resources to develop risk mapping of Dhaka city which cause serious difficulties for location analysis. After handing over the apartments to the respective flat owners, a detailed and updated information of the location, occupancy type, and resident's information should be provided to BFSCDA by the developer companies.

- The developer companies should train their clients on how to practice 3R system in disposing kitchen waste.

- The developer companies should avoid installing grills in the balcony as this is the only escape route during fire hazard in the building especially when the common lobby becomes inaccessible during fire. The fire brigade can easily operate or evacuate people through the open balconies.

- For enhanced security purpose the developer companies should install CC cameras outside the building and in the common areas inside the building. This will help to maintain a good neighborhood watch and reduce the number of stealing or other criminal activities in the area.

- The developer companies should not allow the clients to make internal changes inside their flats such as removing or adding walls to suit their working space as this can have adverse effect on the overall structural design once the structure of the building is constructed.

The remaining wetlands are crucial for Dhaka to keep the ecological balance, especially to reduce the water logging impacts, the Real Estate Developer companies should stop filling up the wetlands for their own benefit and should seek sustainable solution at every stage of development.

-Climate change can increase the likelihood and extent of disasters brought by natural hazards, such as flooding, cyclones, drought and earthquakes. In the urban context, climatic events cause an array of effects, from hindering the city's functionality, to causing injuries and fatalities and increasing future vulnerabilities. Therefore, the Real

Estate Developer companies should consider climate change issues when devising their policies.

5.2 CONCLUSION

The compact, sustainable and efficient use of land in residential area increases the public efficiency by minimizing public or sectoral costs of water supply, sewer system, garbage collection, firefighting, education, recreation, transportation and others. The main loophole in the disaster management area of the city is the lack of coordination among public and private organizations. Successful public and private collaboration can revitalize the urban environment of Dhaka. Participation of different stakeholders is the fundamental instrument for promoting good governance which is the key to achieve social justice. There is no other alternative than maintaining the planning standards and managing the city as per the plan to make the city habitable. By introducing proper policy and planning for disaster management, community awareness build up and training, proper implementation of national building code, well coordination among government organizations and infrastructures and non-government organizations, enrichment of well-equipped rescue team can limit the impact in a manageable boundary.

The Real Estate Developer companies are not contributing to the economic growth of Bangladesh but is also involved in providing grave solutions to national level crisis: habitation for people and disaster mitigation by the construction of permanent and strong buildings. More active and sensitive participation of Real Estate Developer companies can create a sustainable built environment in Dhaka city. The public are conscious enough to prepare themselves for any disaster but developer companies should also consider the sustainable and disaster mitigation issues in their buildings as well. After all the real city is a safe city that ensures the safety and security of its citizens.

REFERENCES

- Ahamad, M. (n.d.). *A Report on Real Estate Sector of Bangladesh*. Research Department, JBBC Corporation .
- Ahamad, S., & Hasan, M. M. (2010). Planned Development for Urban Growth Management: A Case Study on two Wards of Dhaka City. *Journal of Bangladesh Institute of Planner*, Vol. 3, pp. 113-127, ISSN 2075-9363 .
- Ahsan, T. (2016). *High-rise Residential Buildings in Dhaka, Bangladesh: Strategies for Socially and Environmentally Sustainable Practice*. Adelaide: An Unpublished PhD Thesis, The University of Adelaide.
- Bahauddin, K. M., Rahman, M. M., & Ahmad, F. (2014). Towards Urban City with Sustainable Buildings: A Model for . *Civil and Environmental Research*, Vol.6, No.1, www.iiste.org ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online) .
- Banglapedia. (2015, February 19). Flood. Dhaka, Bangladesh.
- Barua, S., Mridha, A. H., & Haque, R. (2010). Housing Real Estate Sector in Bangladesh Present Status and Policies Implications . *ASA University Review*, Vol. 4 No. 1.
- Biswas, K. K., Biplop, N. N., Nesa, M., Monir, R. A., & Noor, S. (2012). *Bangladesh: Disaster Report 2012*. Dhaka: ARKA.
- CDMP. (n.d.). *Earthquake Contingency Plan for Dhaka City Corporation*. Dhaka: Ministry of Food and Disaster Management Earthquake and Tsunami Preparedness CDMP/EC/4a/PC-1 .
- DMB. (2008). *National Disaster Management Policy*. Dhaka: Disaster Management Bureau, Ministry of Food and Disaster Management.
- Ferdous, I., & Rahman, M. M. (2015). CITIZENS AT RISK FROM EARTHQUAKE HAZARD IN DHAKA CITY: SCALING RISK FACTORS FROM HOUSEHOLD TO CITY REGION LEVEL. *J. Geogr. Inst. Cvijic.*, Vol. 65(1) (91–106), doi: 10.2298/IJGI1501091F.
- Forests, M. O. (2016). Chapter 8.6- Urbanization, Housing and Settlement Planning. In *Bangladesh National Conservation Strategy (2016-2031)* (pp. 1-36). Dhaka.
- GED. (2015). *Draft: SEVENTH FIVE YEAR PLAN FY2016 – FY2020, Accelerating Growth, Empowering Citizens, Chapter 9- Urbanization Strategy*. Dhaka: General Economics Division (GED) Planning Commission Government of the People’s Republic of Bangladesh .
- GoB. (April 2010). *National Plan for Disaster Management 2010-2015*. Dhaka: Disaster Management Bureau, Disaster Management & Relief Division .
- Hasnat, M. M., & Hoque, M. S. (2016). Developing Satellite Towns: A Solution to Housing Problem or Creation of New Problems. *IACSIT International Journal of Engineering and Technology*, Vol. 8, No. 1.
- Huq, S., & Alam, M. (2003). Chapter 9, Flood Management and Vulnerability of Dhaka City. In A. Kreimer, M. Arnold, & A. Carlin, *Building Safer Cities: The Future of Disaster Risk* (pp. 121-

- 135). Washington, D.C.: The World Bank, Disaster Management Facility.
- IFRC. (2012). *Sustainable Reconstruction in Urban Areas, Chapter 5 and 6*. Switzerland: Skat, ISBN 978-3-908156-17-8.
- Islam, M. M., & Adri, N. (2008). Fire Hazard Management of Dhaka City: Addressing Issues Relating to Institutional Capacity and Public Perception. *Jahangirnagar Planning Review*, Vol. 6, pp. 5767.
- Islam, M. S. (n.d.). Effects of Real Estate Development on the Built Environment: A Study on Banani Residential Area in Dhaka City. http://www.bip.org.bd/SharingFiles/journal_book/20140427155646.pdf.
- Islam, M. S., Rahman, M. R., Shahabuddin, A., & Ahmad, R. (2010). CHANGES IN WETLANDS IN DHAKA CITY: TRENDS AND PHYSICO-ENVIRONMENTAL CONSEQUENCES. *J. Life Earth Sci*, Vol. 5: 37-42, ISSN 1990-4827.
- Islam, M. S., Sultana, N., Bushra, N., Banna, L. N., Tusher, T. R., & Ansary, M. A. (2013). Effects of Earthquake on Urbanization in Dhaka City. *J. Environ. Sci. & Natural Resources*, Vol: 6(1), Pg-107-112, ISSN 1999-7361.
- Kamruzzaman, M., & Ogura, N. (n.d.). *Apartment Housing in Dhaka City: Past, Present and Characteristic Outlook*. Session A-1: Residential Building/Young Researchers Award.
- Khan, M. (2012). EFFECTS OF HIGH RISE APARTMENTS ON THE HOUSING SITUATION OF DHAKA CITY. *J. Innov. Dev. Strategy*, Vol. 6(1):124-129.
- Labib, S., Bhuiya, M. R., & Rahaman, M. Z. (2013). LOCATION AND SIZE PREFERENCE FOR APARTMENTS IN DHAKA AND PROSPECT OF REAL ESTATE MARKET. *BANGLADESH RESEARCH PUBLICATIONS JOURNAL*, Volume: 9, Issue: 2, Page: 87-96, ISSN: 1998-2003.
- Mahmud, M. A. (2007). *Corruption in Plan Permission Process in RAJUK: A Study of Violations and Proposals*. Dhaka: Transparency International Bangladesh.
- Mowla, Q. A., & Islam, M. S. (2013). Natural Drainage System and Water Logging in Dhaka: Measures to address the Problems. *Journal of Bangladesh Institute of Planners*, Vol. 6, pp. 23-33, ISSN 2075-9363.
- Nabi, A. S., Kamruzzaman, M., Khalil, W., & Khandokar, F. (June 2004). Apartment Housing in High Class Residential Areas of Dhaka City: A Case Study of Dhanmondi, Gulshan and Baridhar. *Jahangirnagar Planning Review*, Vol.2, 33-42.
- Nadiruzzaman, C. S. (n.d.). *Disaster Risk Reduction in Dhaka City-From urban landscape analysis to opportunities for DRR integration*. Australia: World Vision Australia.
- Nahrin, K. (2008). Violation of Land Use Plan and Its Impact on Community Life in Dhaka City. *Jahangirnagar Planning Review*, Vol. 6, pp. 3947, ISSN 17284198.
- Rahman, M. A. (2015). Coordination of urban planning organizations as a process of achieving effective and socially just planning: A case of Dhaka city, Bangladesh. *International Journal*

of Sustainable Built Environment, Vol. 4, 330-340,
<http://dx.doi.org/10.1016/j.ijbsbe.2015.09.003> .

- Rahman, M. M., Paul, S. K., & Biswas, K. (2011). EARTHQUAKE AND DHAKA CITY-AN APPROACH TO MANAGE THE IMPACT . *J. Sci. Foundation*, Vol: 9(1&2): 65-75, ISSN 1728-7855 .
- RAJUK. (2015). *Dhaka Structure Plan 2016-2035*. Dhaka: Ministry of Housing and Public Works, REGIONALDEVELOPMENTPLANNING(RDP).
- RAJUK, R. U. (2015). Chapter 11-RESILIENCE THROUGH DISASTER PREVENTION AND MITIGATION. In *DHAKA STRUCTURE PLAN 2016—2035* (pp. 229-237). Dhaka: Government of the People's Republic of Bangladesh, Ministry of Housing and Public Works.
- Rashid, M. (n.d.). Housing at Uttara Model Town in. *unpublished*.
- Seraj, S. M., & Badruzzaman, A. B. (1997). Potential Hazards and Vulnerability in Urban Development of Dhaka City, Bangladesh. *Engineering Geology and the Environment*, ISBN 9054108770.
- Seraj, S. M., & Seraj, T. M. (n.d.). Problems and Prospects of Tall Buildings in Developing Countries. In *Tall Buildings in Developing Countries*. 165-178.
- Stott, C., & Nadiruzzaman, M. (n.d.). *Disaster Risk Reduction in Dhaka City-From urban landscape analysis to opportunities for DRR integration*. Australia: World Vision.
- Strategy, B. N. (n.d.). Urbanization, Housing and Settlement Planning. Dhaka.
- Thiele-Eich, I., Burkart, K., & Simmer, C. (2015). Trends in Water Level and Flooding in Dhaka, Bangladesh and Their Impact on Mortality. *International Journal of Environmental Research and Public Health* , Vol. 12, 1196-1215; doi:10.3390/ijerph120201196 .
- Yahya, S. M., Shams, S., Islam, A. K., & Mahmud, K. (2010). Climate Change Impacts on Flood Vulnerability for Dhaka City. *Proc. of International Conference on Environmental Aspects of Bangladesh (ICEAB10)*, (pp. 37-39). Japan.

APPENDIX



Fig: C. Interior of an apartment at day time before and after turning on the lights.



Fig: D. Vertical greenery of an apartment



Fig: E. No proper shading device and exposed



Fig: F. No maintenance of exterior facade a.c. outdoor unit



Fig: G. Violation of building code by covering up the void space between two



Fig: H. Violation of building code by covering the setback units for adjoining the two units.area with asbestos sheets.