

## **Knowledge Level of Urban Residents on Disaster Response: A Case Study on Earthquake Response of Chandrima Residential Area Residents, Chandgaon, Chattogram**

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### **Abstract**

People outside the city migrate to Chattogram City for searching job and better services. This process creates tremendous pressure on the urban utility services and making urban sprawl. To meet the housing needs of increased population in the city needs more land for these reason cut the hill, destroy pond, filling up the fallow land, agricultural land and water reservoirs. These reasons increases the earthquake vulnerability in newly formed residential areas in Chattogram. In addition due to geographical location Chattogram is vulnerable in earthquake too. Research observed that house owners were not aware about earthquake resilient construction practices as well as knowledge level of residents on response the earthquake is not satisfactory. So, the absence of the safety equipment's and response knowledge of disaster increases vulnerability level of residential area. This study also suggested to mitigate the vulnerability level of urban disasters particularly on earthquake as using GIS based application on identify the exact location of vulnerable buildings. The GIS application can be used by CDA and City Corporation and concerned bodies to notify the house owners of various actions such as retrofit so that they can make their building better equipped to withstand an earthquake. As well as adopted various awareness program and training to urban residents on earthquake response. Finally, house owners should be made aware on safe construction practices and city authority should monitoring it.

**Keywords:** Disaster, Earthquake, Residential Area, Urbanization, Urban Resident, Vulnerability

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## Introduction

Urbanization is global phenomenon. In 2018, 55% of the world's population residing in urban areas and by 2050, 68% of the world's population is projected to be urban (UN, 2018). In Bangladesh 37.41% of population are now living in urban areas. Chattogram is second largest city in Bangladesh as well the port city [2]. There are about 04 million people live in 160.99 Sq Km. This city is a source of economic activity and better livelihood. Results, marginalized people, displaced people are coming towards the city. To provide the support of influx migrants the city developed haphazardly and unplanned urbanization happening. As a result, growing residential areas possess a great risk of disasters like fire hazards, water logging, structural collapse, earthquake and tidal surges. In regards of earthquake vulnerability, Chattogram City is highly vulnerable to the earthquake disaster. Chattogram region is located at an earthquake risky zone due to Eurasian and Indo-Australian plates, which are still active. Moreover, there are two active seismic faults in Bangladesh one is Sitakunda-Teknaf fault and another is Rangamati-Barkal fault. Geographer predicts that that a moderate to high magnitude earthquake may originate any time from this fault. On November 21, 1997, a total of 25 people were killed in a building collapse at Hamzarbagh, Chattogram City after an earthquake hit the region. Seismic experts said frequent light tremors give a signal that a powerful one is coming up, which is a matter of concern for all. A study of Earthquake Research Centre, Chittagong University of Engineering and Technology (CUET) predicted that the greater Chattogram region is at risk of a powerful earthquake of 7-8 magnitude due to its geological position. About 70 percent of high-rise buildings in Chattogram city will collapse if an earthquake of 7-8 magnitude on the Richter scale hits the city. Residential areas of the city is most vulnerable due to located earthquake-prone zone and violating the building codes and designs. In this regards, it is very important to reduce the vulnerability of earthquake by increasing the knowledge level of urban residents on earthquake response. This study measured the types of disaster in urban areas as well as the knowledge level of urban residents in earthquake response. This study also suggested what steps and action should be taken to reduce the vulnerability of earthquake in urban residential areas.

## Aim and Objectives

The aim of this study to measure the knowledge level of urban residents on responding urban disasters. This paper has two strategic objectives as;

- | To measure the knowledge level of residents on earthquake response
- | To provide some suggestions on mitigating the vulnerability of urban disasters particularly on earthquake in Chandrima Residential area, Chattogram and elsewhere.

## Methodology

The study is mainly based on primary field survey which was conducted during the month of January to March, 2020. The primary survey included urban residents data which was collected from to residents/house owners and an opinion survey of expert group. The Questionnaire was developed with the base of literature review and opinion of expert group. So, the main tools of this research are Questionnaire Survey, Key Informant Interview (KII), Literature Review and buildings spatial Analysis. In that research 95 questionnaires were conducted and 25 variables are in a questionnaire. The study also conducted 4 Key Informant Interviews of experts. The survey was conducted on Chandrima Residential Area, Chandgaon, Chattogram. This is newly formed residential area which is under of Chattogram Development Authority (CDA).

## Findings and Discussion

The remarkable findings of this research are discussed in below. Later on with the base of findings necessary suggestion are prescribed.

### ***Urban Environmental Problems in Chattogram City***

Chattogram is unclassified, irregular and heterogeneous in character of its land use [4]. It is very difficult to identify the zoning in a particular area. Unplanned urbanization creates chaotic development in this city. People outside the city migrate here for searching job and it creates pressure in the city to survive. For this reason now

Chattogram city is suffering various natural and manmade problems. Every year land slide causes many loss of life because many people live under the hill. No one obey the rules of hill cutting. It is now a burning issue for Chattogram. According to the Department of Environment, Chattogram, and the district administration have identified 30 hilly areas in Chattogram as risky. 2000 families are at high risk, 4000 to 6000 families are at medium to low risk. In Foy's lake area 5000 families are at risk. Now the city is very much affected in water logging problem in rainy season. It is also a result of unplanned urbanization. The inhabitants of the city do not obey the zoning regulations, they construct there buildings and block the natural drainage system. For constructing new buildings they need more land as the population of the city is increasing at an alarming rate for these reason they destroy pond and other water reservoirs. This reason increase the earthquake vulnerability in Chattogram. Because most of the residential areas are built on cutting the hills as well as filled the water reservoirs. In addition due to geographical location Chattogram is vulnerable for earthquake too. In survey it was revealed that the Chnadirma Residential Area was fallow lands and seasonal water reservoir. Every year this residential area is affected in water logging in rainy season. Moreover, due to dense urban areas especially in urban slums and utilities failure with hazardous materials spill in urban areas are also vulnerable in fire risk.

### ***Earthquake Records and Vulnerability of Chattogram***

An earthquake is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. Chattogram is vulnerable to seismic activity. Chattogram region is located at an earthquake risky zone. According to Bangladesh National Building Code (BNBC)-2017, Bangladesh divided into four main earthquake zones;

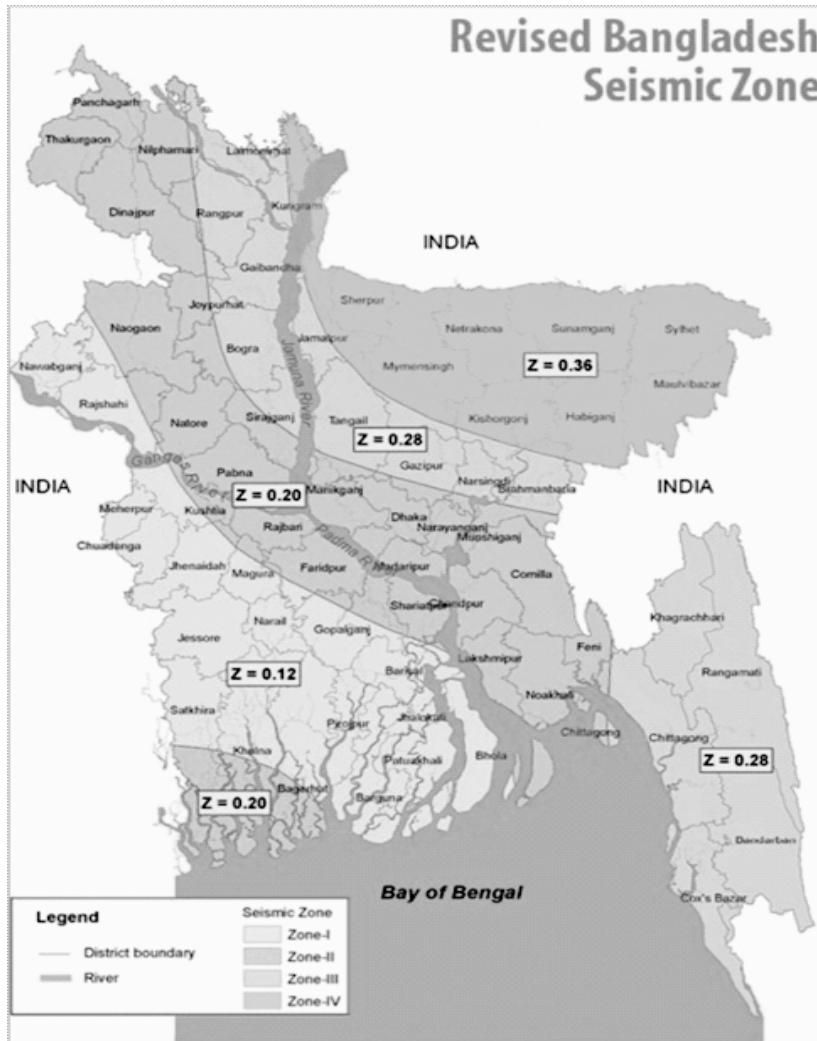
**Zone-1:** Sylhet-Mymensingh is with the possible magnitude of 7 on Richter scale.

**Zone-2:** Chittagong, CHT, Tangail and some parts of Rangpur are with the possible magnitude of 6 on Richter scale.

**Zone-3:** Cumilla, Dhaka, Dinajpur, Natore and some parts of Khulna of the

country is with possible magnitude of 6 on Richter scale.

**Zone-4:** Jessore, Barisal, Rajshahi are with the possible magnitude of 5 on Richter scale



**Map-01:** Earthquake Zones in Bangladesh (source: BNBC, 2015)  
Chattogram is located on Zone-02. Bangladesh has not been affected by any large earthquakes, the evidence of large scale earthquakes in the region serves as a reminder of the possibility of big earthquakes

in the future. Past major earthquakes in and around Bangladesh include the 1548 earthquake that hit the Sylhet and Chattogram regions, the 1642 earthquake in Sylhet District with damage to building structures, 1762 earthquake hit most part of Bangladesh including Dhaka and Chattogram caused loss of life and properties.

In 1997 Chattogram earthquake, or the 1997 Bandarban earthquake, occurred on November 21, 1997 at 11:23 UTC in the Bangladesh-India-Myanmar border region. It had a magnitude of Mw 6.1 (USGS, 2014). The epicenter was located in southern Mizoram, India. While no fatalities were reported in Mizoram, India, however, 25 people were killed when a 5-storey building collapsed in Chattogram, Bangladesh.

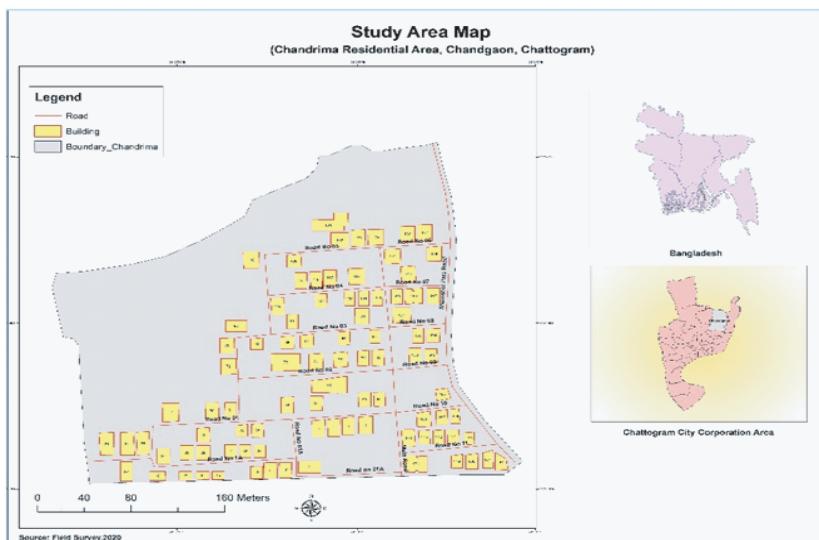
An earthquake occurred on 22 July, 1999 at Moheshkhali Island with the epicenter in the same place, a magnitude of 5.2. The earthquake was severely felt around Moheshkhali Island and the adjoining sea. Houses cracked and in some cases collapsed.

The Borkol earthquake occurred in the early morning of 27 July 2003 at 5:18:17.96 am local time, killed three people, injured 25 people and damaged about 500 buildings in Chattogram and the Chattogram Hill Tracts. Power supply to some areas was cut as a transformer exploded at the Modunaghat Grid Substation in Hathazari, Chattogram. The epicenter was situated 217 km southeast of Dhaka at the eastern bank of Kaptai reservoir. It had a magnitude measured Mw 5.7. Dhaka shook with MM intensity IV. Many people were awakened, especially residents of upper floors of high rise buildings. On that analysis, it can predict that a moderate to high magnitude earthquake may originate any time of Chattogram Zone.

### ***Description of Study Area***

Chattogram known as the Port City of Bangladesh. The city is located on the banks of the Karnaphuli River. Chittagong City Corporation area 160.99 Sq. Km. Chattogram City Corporation is divided into 11 thanas. These thanas are subdivided into 41 wards and 211 mahallas. Modern Chattogram is Bangladesh's second most

significant urban center after Dhaka. The population of the Chattogram is not likely to be 107.76 million in 2050, with more than 56.4 percent being urban area. Population of the city is increasing very rapidly due to economic opportunity and poverty-reduction benefits associated (Samad et.al, 2016). As rapid urban growth started to take place as increased people have created tremendous pressure on the urban utility services and making urban sprawl. To meet the housing needs increased population in the city, many residential areas in the city have been developed with public and private supervision. Chandrima Residential Area, Chandgaon is one of them. Chandrima Residential area is about 0.54 Sq. Km. There are about 95 buildings where about 4000 population lives in this residential area (Map-01). From map, it was observed that most of the buildings are located in planned, some plots are still vacant and some are under construction. This residential area is under of Chattogram Development Authority (CDA). This area has a Kollan Samity.

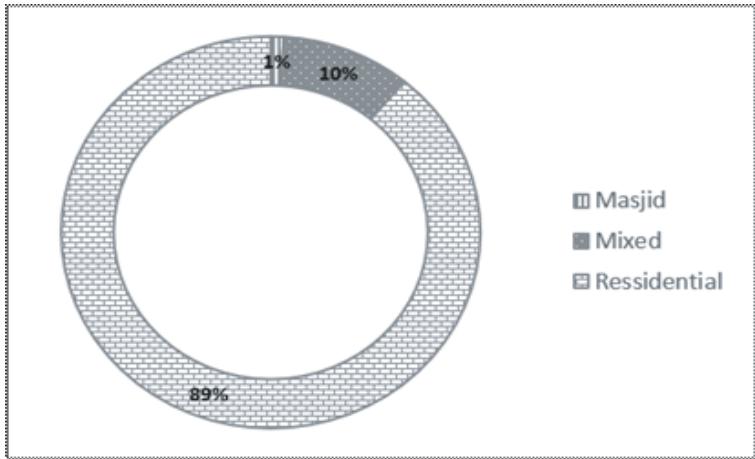


**Map-02:** Study Area Map (Chandrima Residential Area, Chandgaon, Chattogram)

### Number of Floors and Occupancy of Buildings in Chandrima Residential Area

The study observed that, in Chandrima's maximum buildings number of floor is 6 to 7 (above five) and its percentage is 84% and rest of buildings are one to five floor. And hundred percentage buildings has done piling while constructing the buildings. It is good sign on preventions of earthquake vulnerability. The study also observed that, in Chandrima's maximum buildings occupancy are residential and its percentage is 89% and very few numbers of buildings are uses in mixed purposes, its percentage is 10%. Mixed occupancy means these buildings are uses business, residence and educational purposes. Mixed uses buildings are more vulnerable in earthquake.

**Figure-01:** Occupancy of Buildings in Chandrima Residential Area



*Source:* Field Study, 2020

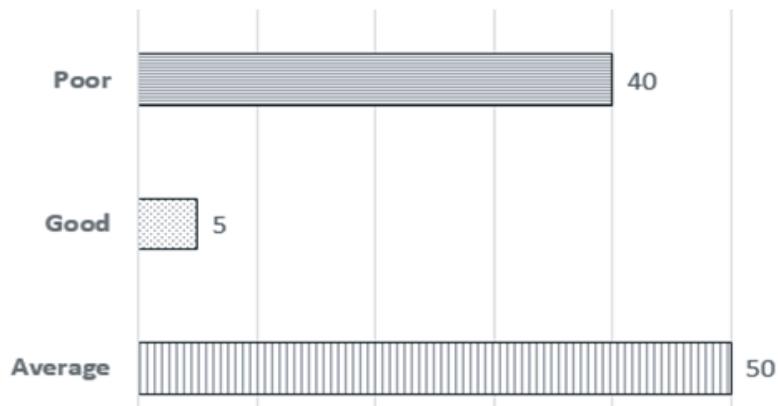
### Safety Measures and Equipment's in Residential Area Buildings

Research observed that only 32% of buildings of Chandrima has safety equipment's and measure as fire extinguishers, fire alarms and exit signs. But a large number of buildings has no any safety equipment and measure as smoke detectors, two exits, obstructed stairs, no electric outlet and outdoors are obstructed etc. So, the absence of these safety measure and equipment's increases vulnerability level of residential areas buildings in earthquake.

### Knowledge level of Residents on Earthquake Response

From participants interviewed, overall 100 percent of them had

already experienced in earthquake. In study it was observed that participant had a poor level of knowledge and attitude towards earthquake response and safety. This statistics can be further explored in Figure-02 below.



**Source:** Field Study, 2020

It interesting findings that only 5 of respondents has good knowledge on earthquake response and rest all participants' knowledge level is fair low on that same way their urban risk preparedness knowledge level is minimum. Though all residents in this area are well educated and economic condition is good. So, the absence of these response knowledge might increase vulnerability level in residential area in earthquake.

### **Suggestions on mitigating the vulnerability of urban disasters with earthquake**

Unplanned urbanization exaggerated the urban environmental problems. Rapid urbanization combined with rapid improvement in standards of living is stretching natural resources and threatening environmental quality in urban areas. The urban areas are facing a range of environmental challenges including contamination of air, water and soil. Sprawling urban areas contribute to traffic congestion, with associated air pollution, noise and long commuting times affecting public health and productivity across the world. In addition, climate change is likely to aggravate certain urban health risks and inequalities by increasing the frequency and severity of extreme weather events (heat waves, storms, floods, frequent earthquakes),

potentially contributing to air pollution episodes (ground-level ozone and pollen) and disturbing urban ecology (Vardoulakis, S., Dear, K. & Wilkinson, 2016). This research also identified the mitigating measures on reduction the vulnerability of urban disaster as;

- Planned urbanization and implementing building codes
- Strengthening policies and institutions with implementation
- Extending social safety and protection
- Economic diversity and sustainable livelihoods at roots.
- Improving early warning and monitoring system.
- Using local knowledge, resource mobilization and innovation to build a resilient environment.
- Consider disaster risk reduction as a part of urban planning regulations, relocation, plans development activities (Parvin *et.al*, 2013)
- Design and plan for hazard-resistant infrastructure or improving existing facilities (Parvin et.al, 2013)
- Establishing education, awareness, outreach campaign, training and capacity development programmes;
- Involvement multi-stakeholders with dialogues and ensure inclusion at all level policy to implementation.

## **In regards of Earthquake Vulnerability Mitigation**

Research observed that buildings are the major components that cause disaster during earthquake, it is essential to study the state of buildings in the country mainly the residential areas of urban. For this GIS can massively help as it can be used to not only identify the buildings that needs to be addressed but locate them as well. This study also measured the knowledge level of residents on response the earthquake. Research observed that house owners were not completely aware about earthquake resilient construction practices. Furthermore, it is also indicated that special attentions should be given to existing house to promote activities such as retrofit for giving them a better chance to withstand earthquakes. For this as well, house owners should be made aware of possible solutions of making house more earthquake resilient. This can further be used to develop plans for activities such as awareness program and trainings on safe construction practices. This can even be used to create an emergency rescue plan for the city authority. Furthermore, by using this approach as GIS

based application can identify the exact location of buildings which can be used by CDA, City Corporation and concerned bodies to notify the house owners of various actions such as retrofit so that they can make their building better equipped to withstand a major earthquake.

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