DRAFT

Government of the People's Republic of Bangladesh

Earthquake Contingency Plan for Ward 13

Tangail Pourashava

March 2020

Department of Disaster Management

Ministry of Disaster Management and Relief

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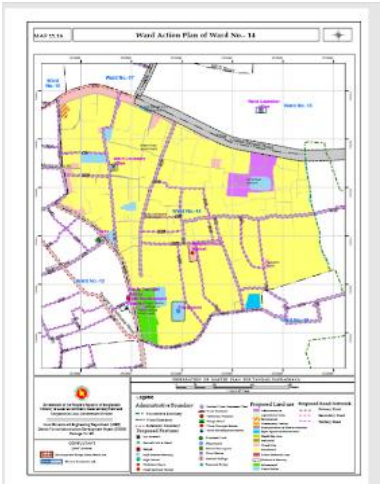

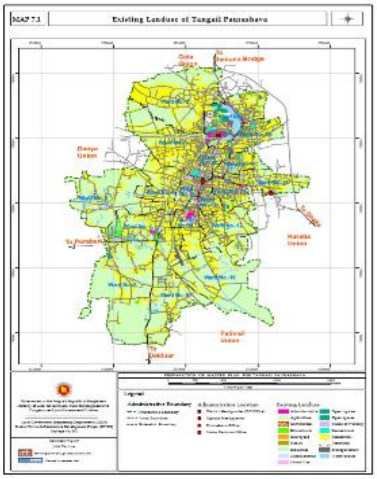

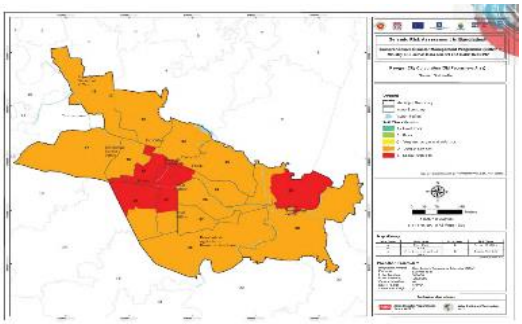

National Resilience Programme

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CHAPTER 1: INTRODUCTION

Earthquake can occur without any prior warning resulting in widespread damage; high numbers of fatalities and injuries; destroying buildings and other physical infrastructure and facilities. It may have adverse effect on economic, social and political sector which can drive the entire nation to disastrous consequences (CDMP, 2014). To mitigate the earthquake risk proper planning and management are required through investigating the interrelated issues based on earthquake vulnerability assessment.

1.1. Background of the Project

Bangladesh is geographically vulnerable to earthquake due to the existence of several fault lines and tectonic plate boundaries. Historical evidences of earthquake including their severity near and within the country compound the future threat. Moreover, rapid urbanization, population growth, migration and development of economic activities are also inducing impetuous increase of vulnerability (CDMP, 2014). A severe earthquake in this country will cause a large number of human casualties, huge damages of infrastructures, social and economic loss etc. and a big earthquake is anticipated in near future (Alam et.al, 2008). To ensure a useful response to a severe earthquake in an area; an organized earthquake risk management planning is essential at local level, including contingency plan based on seismic exposure assessment and building and socio-economic vulnerability assessment. Seismic exposure assessment brings out the seismic risk of an area and building vulnerability assessment provides an understanding about the vulnerability of buildings in an area based on their general characteristics as a whole (NORSAR, 2018). Socio-economic vulnerability assessment reveals the community's characteristics leading to their earthquake vulnerability and the potential impact of earthquake on their social and economic life (Lal et.al, 2011). Contingency planning is a course of actions which aim to prepare an entity to respond well to an emergency and its potential humanitarian impact (CDMP, 2014). Development of a contingency plan may involve decision making in advance about the management of human and financial resources, coordination and communications procedures, and responsiveness of a range of technical and logistical support.

As Bangladesh hopes to upgrade from Least Developed Country (LDC) category by 2024, disaster risk reduction remains a key priority of the Government of Bangladesh, which is

reflected in its 7th Five Year Plan, Bangladesh Delta Plan and various national policies. Bangladesh has also adopted global frameworks like SDGs, Sendai Framework etc. However, Bangladesh has to maintain a holistic approach and to mainstream disaster risk reduction into development planning based on past achievements and lessons. Bangladesh government and United Nations Development Programme (UNDP), UN Women and United Nations Office for Project Services (UNOPS) have jointly initiated the National Resilience Programme (NRP) with the financial support of the Department for International Development (DFID) and the Swedish International Development Cooperation Agency (SIDA) to sustain the resilience of human and economic development in Bangladesh through an inclusive and gender responsive disaster management. The programme aims at to provide strategic support to improve national capacity to keep pace with the changing nature of disasters.

The programme consists of four sub-projects or parts. Each sub-project is implemented by one implementing partner from the Government. These implementing partners are: Department of Disaster Management (DDM) of the Ministry of Disaster Management and Relief, Department of Women Affairs of the Ministry of Women and Children Affairs, Programming Division of the Ministry of Planning, and Local Government Engineering Department of the Ministry of Local Government, Rural Development and Co-operatives.

In NRP, DDM part aims to work towards improving community resilience by creating replicable, cost-effective models around DRR inclusive social safety nets, pro-active response solutions, earthquake preparedness, search and rescue, community-based flood preparedness that have shown promise in earlier initiatives. The objectives of the Department of Disaster Management part are:

- To advocate for implementation of the Sendai framework and build necessary capacity to monitor the implementation.
- To strengthen disability-inclusive, gender-responsive national capacities to address recurrent and mega disasters (including training of key personnel).
- To strengthen disability-inclusive, gender-responsive community preparedness, response and recovery capacities for recurrent and mega disasters.

As earthquake is a sudden perilous natural disaster and it can cause large scale damage, an inclusive earthquake risk management approach is required to minimize the loss. To ascertain an effective response to severe earthquake event; an organized earthquake risk management

planning is necessary at local level, including contingency plan based on soil characteristics, structural analysis of building and socio-economical context. Realizing this National Resilience Programme (NRP) under the Ministry of Disaster Management and Relief of the People's Republic of Bangladesh has taken initiative to develop a minimum preparedness package for earthquake preparedness for the cities. Activities are implemented in Rangpur, Tangail, Rangamati and Sunamganj. This report covers the initial assessment for preparing contingency plan of a ward of Tangail Pourashava

1.1.1. Experience from Mymensingh Pourashava

BUET and UNDP conducted similar project in Ward 14 of Mymensingh Pourashava in the year 2016-2017. This research work was undertaken to develop community-based earthquake risk reduction and management plan in Ward No. 14 of Mymensingh Pourashava. For the purpose, the research team prepared a contingency plan for the study area in consultation with the local community. The tasks included assessment of seismic risk, assessment of the building and socio-economic vulnerability, and finally preparation of earthquake contingency plan for the area. The project was launched through a workshop at Mymensingh Pourashava on 6th April 2017. This consultation workshop helped the researcher to understand the issues and to determine the scope of the work.

The earthquake contingency plan prepared to reduce seismic vulnerability of the study area includes temporary shelter planning, emergency health facility planning, Ward Co-ordination Center planning, evacuation route planning, and household level preparedness planning. For temporary shelter demand, two scenarios were considered. In Scenario-1, it was assumed that 50% residents of buildings which will collapse or damaged during an earthquake would need shelter. It was estimated that around 2,273 people would need shelter in this scenario. On the other hand, in Scenario-2, it was assumed that all the residents of the contingency plan area would require temporary shelter. Considering the preference and acceptability of local people, structural safety and accessibility of the proposed shelter, 28 places were identified for temporary shelter in dry season including open spaces, educational institutions and religious places and 24 places in wet season including open spaces, educational institutions and religious places. These places could accommodate 11,277 people in dry season and 5,209 people in wet season.

Considering preference and acceptability of local people, structural safety, and accessibility, 26 health facilities including hospitals, clinics, and diagnostic centers in the study area were

proposed to serve the injured people after an earthquake. Comparing the availability and probable requirement it can be concluded that the facilities within the study area are enough to treat the estimated injured persons after an earthquake. To ensure proper management of these temporary shelters and emergency health facilities, Temporary Shelters Management Committee (TSMC) and Emergency Health Facility Management Committee (EHFMC) were proposed with their composition, role, and responsibility in different phases of disaster management. These proposed committees need to coordinate their activities in consultation with the Ward Disaster Management Committee (WDMC).

Considering road blockage condition, road width, and accessibility, it could be observed that most of the roads in the large portion of the area would become inaccessible. Considering these, representatives from the study area suggested that some roadblocks be removed by retrofitting corresponding vulnerable buildings. It was found that the roads in the proposed evacuation route has road width less than or equal 6ft. These roads will be only accessible by walking, cycle or motorcycle, one-way rickshaw or van. Thus road widening initiative by the Pourashava is necessary. To access narrow roads, customized non-motorized vans can be used during a rescue operation in disaster.

To ensure proper preparedness at the household level, awareness programs, workshops, training and mock drills should be organized by WDMC to train them about how to respond during and immediately after an earthquake. A family emergency plan should be developed and practiced regularly, and emergency kits should be kept ready by the households which would contain necessary products to sustain after an earthquake, e.g. water, non-perishable food, medicine, flashlight, cash, first aid box, etc.

From this research it was realized that earthquake vulnerability assessment of an area is required to identify the earthquake risks of an area and take precautionary measures to minimize them. A contingency plan based on the result of vulnerability is the pathway to raise awareness among the residents. This contingency plan is neither a standalone document nor a static document. It should be an ongoing process integrated and coordinated with activities of other documents.

1.2. History of Earthquake in Tangail

As Bangladesh is located very adjacent to the margins of Indian, Burmese and Eurasian plates and is susceptible to frequent earthquakes. Besides, The country’s position adjacent to

the very active Himalayan front and ongoing deformation in nearby parts of south-east Asia expose it to strong shaking from a variety of earthquake sources that can produce tremors of magnitude 8 or greater. Historical seismicity within Bangladesh indicates that potential for damaging moderate to strong earthquakes exist throughout much of the country (CDMP, 2009) including Chittagong, Sylhet, Dhaka, Rangpur, Bogra, Mymensingh, Comilla, Rajshahi are very much vulnerable to a major earthquake disaster. During the last 150 years, seven earthquakes of large magnitude (Richter magnitude M≥7.0) with epicenters in India and Bangladesh have affected Bangladesh (Al Hussaini, 2016). Other than that Bangladesh has regularly faced many small earthquakes.

Figure 1. 1: Revised seismic zoning of Bangladesh
(Source: HBRI, 2015)

Tangail is located at the active Madhupur fault and the district is also very close to Dauki fault. According to Revised Seismic Zoning Map of BNBC Tangail belongs to Seismic Zone 3 (Figure 1.1). The geotechnical and geophysical investigation under CDMP II shows that almost total pourashava area is consist of soil which is dense or stiff except Ward No. 13 which is the study area of this project. This ward mostly consists of Loose/ soft soil (Figure

1.2). Besides Peak Ground Acceleration value of the wards varies up to 0.26 which has been illustrated in Figure 1.3 (CDMP, 2015).

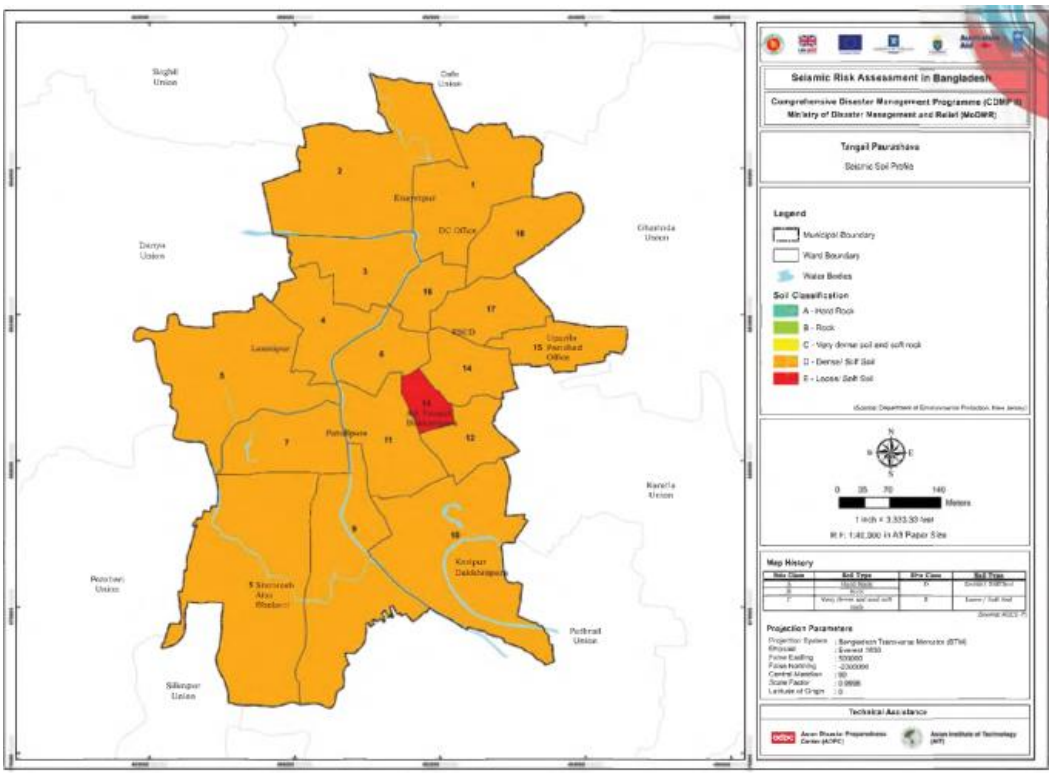

Figure 1. 2: Soil profile map of Tangail pourashava (Source: CDMP, 2015)

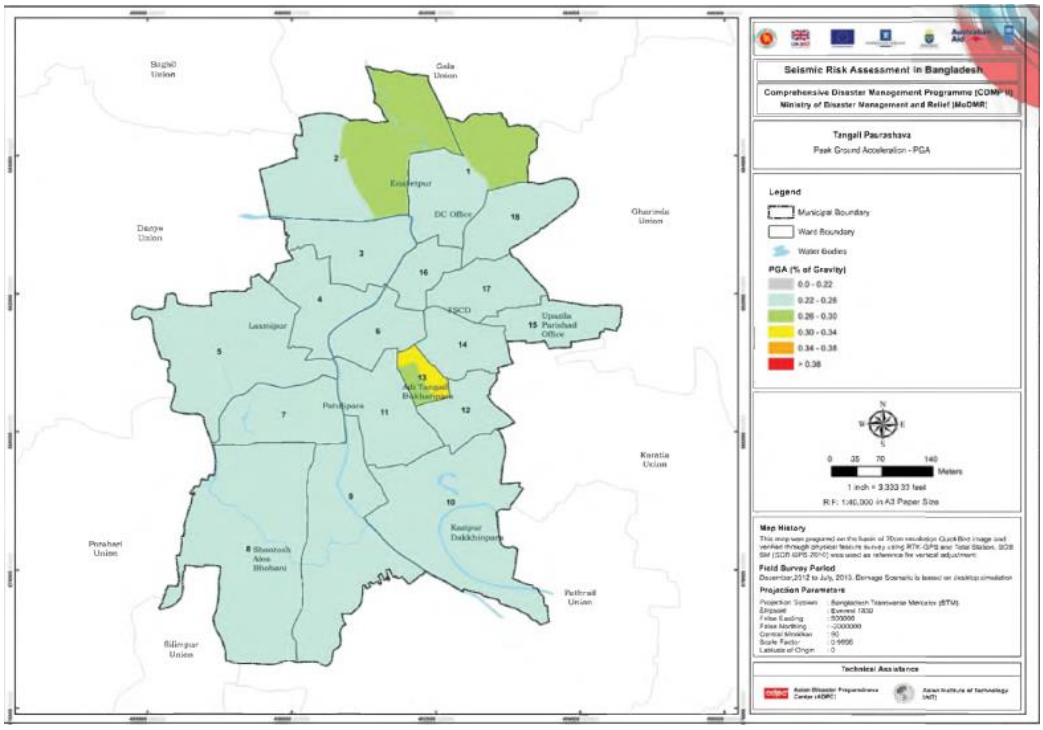

Figure 1. 3: Peak Ground Acceleration map of Tangail Pourashava (Source: CDMP, 2015)

Among the wards of Tangail pourashava, Ward no. 13 has higher PGA value than the other wards which indicates that Ward no. 13 is more susceptible to liquefaction. It is evident that Rangpur faced a huge damage in the Great Indian Earthquake in 1897. Track of Brahmaputra River moved which caused disruptions of river transport (Source: Ansary et al., 2003). No severe earthquake after 1897 is seen here. But because of its geographic position and geology of Madhupur tract Tangail Pourashava is prone to earthquake.

1.3. Aim of the Project

The aim of the project is "Building earthquake resilient community through vulnerability assessment, capacity and awareness building and promoting safe construction practices".

1.4. Objective of the Project

The objective of the project is to prepare a contingency plan to support the response for saving lives, properties and addressing immediate humanitarian needs of the people affected by an earthquake event. Under the main objective the followings will be achieved:

- Saving lives and reduce suffering by providing and/or ensuring equitable access to multi-sectoral assistance to affected populations of the ward with particular attention to those most affected and the most disadvantaged groups.

- Protecting the rights of those most affected, and promote inclusive and equitable access to humanitarian assistance, with particular attention to the most disadvantaged groups.

- Supporting the recovery of the most affected by protecting, restoring and promoting their income, livelihoods and well-being with specific focus on the needs of women including women heads of households.

1.5. Scopes of the Project

The scope of the project involves assessment of earthquake vulnerability and response capacity of Rangpur City Corporation and Tangail, Rangamati and Sunamganj pourashavas. The contents of training on earthquake preparedness would be prepared for trainers and training would be also imparted in this assignment. Guidelines for Risk Sensitive Land Use Planning based on the vulnerability assessment would be developed with Ward level Risk Reduction Action Plan. Ward and household level Contingency Plan also would be developed with household level information. If City/Pourashava level Contingency Plans is

not available it will be developed and where it is available it would be updated. To facilitate vigorous awareness campaign in inclusive manner education and communication materials also would be prepared. Adequate policies would be identified for proper building approval, building code enforcement and construction monitoring by the local government.

1.6. Organization of the Report

There are seven chapters in this report. In chapter one, background and objectives of the research have been discussed. Chapter two focuses on the profile of study area including the geographic, demographic and other characteristic of the study area. Chapter three describes the sequential steps of methodology through which the aim and objectives of this research have been achieved. Chapter four and five describes the assessment results of seismic exposure and building vulnerability of the study area. In chapter six socio-economic vulnerability assessment results of the study area have been discussed. Chapter seven concludes with some future scopes of this contingency plan during and after an earthquake event.

CHAPTER 2: STUDY AREA PROFILE

Tangail Pourashava is situated at Tangail district in Dhaka division. It is located on the Seismic Zone-3 of Bangladesh and was established in 1984 (BBS, 2011c). The total population is 167412 with density of 1559 persons per sq.km (BBS, 2011c). Among the 18 Wards of Tangail Pourashava, Ward No 13 was selected as the study area for this project.

2.1 Location of the Study Area

The study area is located at the north-eastern side of the Pourashava. Figure 2.1 shows the location of the Tangail Pourashava in Tangail Sadar Upazila as well as the ward map of ward 13.

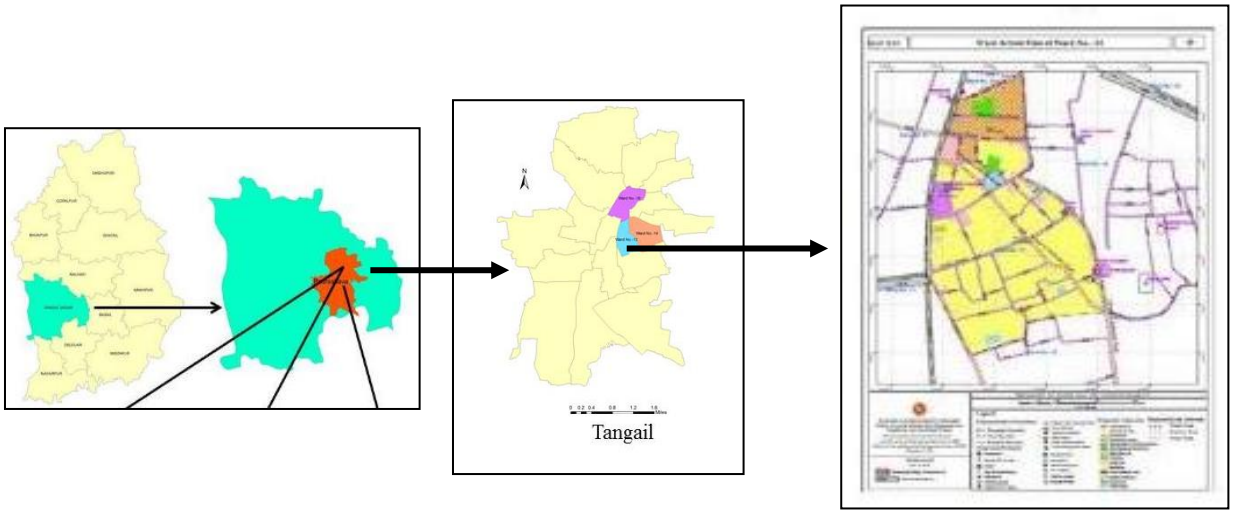

Figure 2. 1: Location map of Ward 13 of Tangail Pourashava (Source: Tangail Pourashava, 2010)

2.2 Demographic Profile of the Study Area

The population of the Ward 13 is 7572. The ratio of male and female population, average household size and literacy rate of ward 13 of Tangail pourasahava is included in Table 2.1.

Table 2. 1: Male, female ratio, HH size and literacy rate at ward 13 of Tangail Pourashava

Ward No	Male (%)	Female (%)	Average Household (HH) Size	Literacy Rate (%)
13	51.9	48.1	4.3	84.9

(Source: BBS, 2011c)

Table 2.2 shows the age-wise distribution of population at ward 13 of Tangail Pourashava which can contribute to the social vulnerability of the area. Service is the dominant occupational activities of the study area over the agricultural and industrial activities.

Table 2. 2: Age-wise distribution of population at ward 13 of Tangail Pourashava

Ward No	**Percentage of Population at Different Age Group**					
	0-9	**10-19**	**20-29**	**30-49**	**50-59**	**60+**
Ward 13	16.7	18.2	17.6	31.9	7.7	7.9

(Source: BBS, 2011c)

2.3 Existing Land Use of the Study Area

Figure 2.2 reveals that the major land use of ward no 13 is residential (72.9%). The northern part of ward 13 is mainly commercial land use based and the southern part is residential land use based. Structures serving health facility (0.52%) are very negligible to be counted and are located in the south-western part of the ward. There are equal number of structures of educational institutions (0.31%) and administrative offices (0.31%) in this ward. A good percentage of land use is for mixed purpose (7.03%). A major portion of land is also for accessibility even though the adjacent road network of many households is too narrow. A significant number of water body and open space is found in this ward. There is also space for socio-cultural use in ward 13.

2.4 Profile of Built Structure in the Study Area

If the structures are described according to their types it was found that 41% of the structures of ward 13 of Tangail Pourashava are pucca, 28% are semi pucca and the rest are kutcha. Number of stories varies from 1 to 20 among the pucca buildings. Distribution of pucca building according to their stories is shown in the following Table: 2.3.

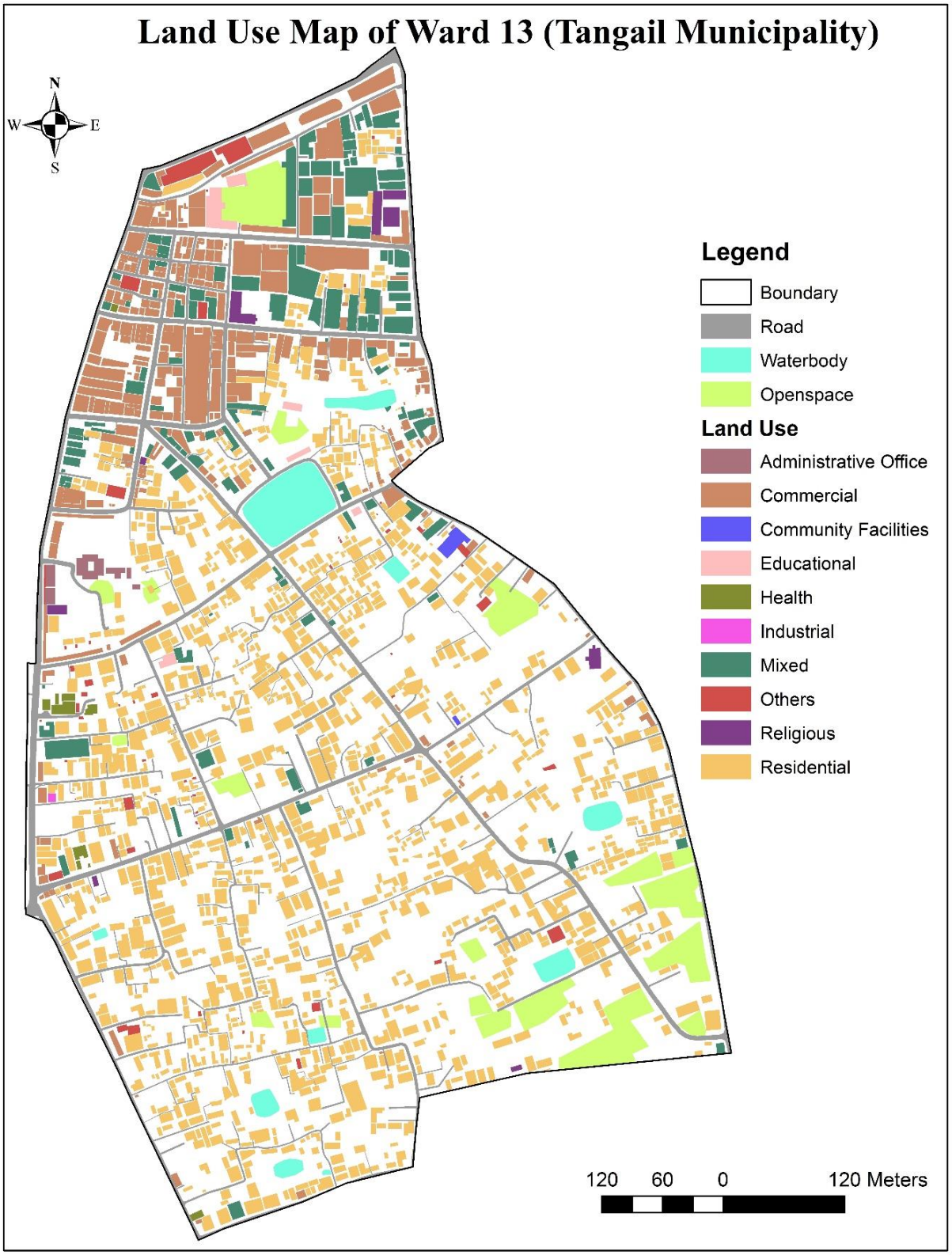

Figure 2. 2: Map showing land use of Ward 13, Tangail Pourashava

Figure 2. 3: Distribution of pucca structures according to number of storey in Ward 13

Number of Story	Number of structures
Number of 1 to 3 storied building	600
Number of 4 to 6 storied building	171
Number of 7 or higher storied building	21
Total	**792**

Source: (Field Survey, 2020)

Among the surveyed buildings, 72.9% are of residential use, followed by commercial uses (15.25%). There is only one industrial building in the locality. Apart from these uses, some buildings are used for urban services and socio-cultural purposes. Figure 2.4 shows frequency of different building uses in ward 13 of Tangail Pourashava.

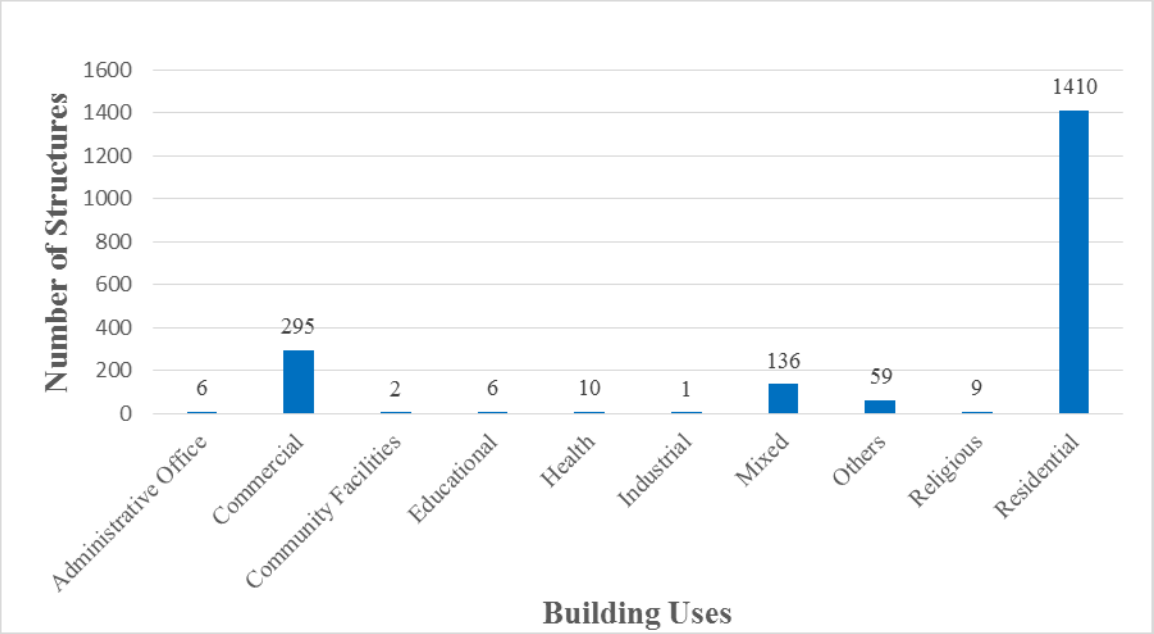

Figure 2. 4: Building Use in Ward 13, Tangail Pourashava (Source: Field Survey, 2020)

There are total 33 public buildings in ward 13. Buildings for administrative purpose educational and religious use, health facility and community facilities have been considered as public building in this project. Among them, 6 buildings are administrative offices, 6 buildings are educational, 10 buildings provide health facilities, 9 buildings are for religious purpose and 2 buildings are for community facilities.

CHAPTER 3: METHODOLOGY

3.1 Introduction

There is not a single method to determine socio-economic and building vulnerability of community due to earthquake. As contingency plan is dependent upon socio-economic and physical context, a comprehensive methodology is needed to cover the issues. Thus a comprehensive approach has been taken to prepare the contingency plan considering socio-economic vulnerability of community as well as physical vulnerability of the area. For this research, both primary and secondary data were collected. A questionnaire survey and engineering survey were conducted to understand the socio-economic context and physical vulnerability of the area and structures. In addition, secondary data on land use, institutional capacity were collected. Once the data were collected, it was verified and analyzed and some data will be analyzed. Later community-based approach will be taken for capacity and awareness building and promoting safe construction practices. In this way some initiatives have already been taken which are brought in light at this chapter. The following sections provide the detail description of the methodology.

3.2 Project Initiation

The project was initiated through inauguration workshops in an interactive way at Tangail Pourashava on 07 November, 2019 by introducing the aims and objective of this project. The Honorable Mayor of Tangail Pourashava Mr. Md. Jamilur Rahman Miron chaired the workshop. Prof. Dr. Shakil Akhter and Mr. Md. Aminul Islam were present from BUET. The Honorable Project Director of NRP along with other officials from UNDP also attended the workshop. In the presentation by BUET the work plan and expected outcomes were discussed.

Figure 3. 1: Inauguration Workshop at Tangail Pourashava

The objective of the National Resilience Program was presented in another presentation by UNDP. The workshop was attended by ward councilors of Tangail Pourashava, government officials, members from civil society, volunteers from Bangladesh Red Crescent Society, and National Cadet Corps. An open discussion session took place among the participants. They provided their suggestions about how this program can be made successful and expressed their willingness to support the authorities in this process.

3.3 Secondary Data Collection

One of the most important data for the research is GIS database of the study area. From Tangail Pourashava office, the GIS database had been collected which was last updated at the year of 2010. The database contains data on area boundary, structures type, land use and road network. This database had been used to prepare the base map of ward 13 of Tangail Pourashava. Some policy documents such as Building Construction Rules (1996) and project reports such as Comprehensive Disaster Management Programme (CDMP) for Tangail Pourashava had been reviewed to identify the previously collected data on development pattern, soil characteristics etc. of the study area.

3.4 Primary Data Collection

Social survey was conducted to assess the socio-economic vulnerability of the study area. Engineering surveys were conducted to understand the soil characteristics and physical vulnerability of structures. Microtremor test was used to understand the seismic vulnerability. To assess the vulnerability of buildings of the study area, two methodologies were used: RVS (Rapid Visual Screening) as suggested by FEMA (Federal Emergency Management Agency, USA, 2017 edition) for preliminary assessment and DEA (Details Engineering Assessment).

3.4.1 GIS Database Updating

The collected GIS database from Tangail Pourashava was last updated at 2010. Therefore, it was necessary to update the information of this database due to huge development at the study area from 2010 to 2019. At the preliminary stage the team used Google earth image to identify land cover and in some cases land use, by employing Google earth tag. As the Google images are available upto 2018, field verification was conducted to identify the development between 2018 and 2019 as well as identifying the land use. In the field

verification process non-spatial data (for example: building storey, building use, road width etc.) were also updated.

3.4.2 Updating of GIS Spatial Data through Satellite Image Processing

The spatial database of GIS had been updated from the satellite images available at Google Earth found from Landsat images of 2018. Existing newly built structures, water bodies, open spaces, barren lands etc. were digitized at this stage for the study area (Ward 13). Further satellite updated maps were prepared for Ward 13 of Tangail Pourashava. After completion of satellite updating, it had been found that almost 363 new buildings were constructed in between 2010-2018. The field updating has been conducted to trace the development pattern after 2018.

3.4.3 Checklist Preparation

Before collecting the information of newly built structures from the field, a checklist has been prepared. The checklist included building use (in detail extent as much as possible: Residential, commercial, health, educational, religious, community facility, mixed etc.), type of structure (pucca, semi pucca and kutcha), number of storey etc. (Appendix C). This checklist has been prepared at "KoBo Toolbox". Surveyors were asked to mark road width, presence of open space and waterbody in the hard copy of map during field verification.

Table 3. 1: Attributes had been considered at updating stage (Checklist)

Attributes for collecting information using KoBoToolbox	
Ward No	Type of Structures
Building ID	No of Storey
Holding No	Building Use
Width of Adjacent Road	

3.4.4 Training of the Volunteers

Local community plays the role of first responders in case of any disaster. Therefore, strategies for local empowerment and capacity building are needed in order to ensure effective disaster mitigation (Shaw, 2012). Community-specific training programme is an important tool which utilizes local knowledge and enhances the potential of local residents (Rivas and Kilmer, 2016). Community members of the study area were engaged to collect the data. They were trained so that they can assist in updating the existing GIS maps. The

activities under this task involve training the volunteers about how to interpret the maps and update the structures on map, how to enter the information of structures at "KoBoToolbox" and how to form the groups to conduct the field verification. In Tangail Pourashava, the training was organized on 03 December, 2019 (Tuesday) at the seminar room of S.S.S. Rest House. It was attended by 10 (ten) members of Bangladesh National Cadet Corps (BNCC) of Tangail, among them 6 (six) were female students. The volunteers were instructed by 2 (two) research assistants and 2 (two) technical officials of BUET-JIDPUS. An interactive discussion was held about the project background, rationale of selecting Ward 13 and the importance of updating maps for effective contingency planning. Later the volunteers were trained regarding the survey procedure, i.e. how to read maps, explanation of different variables related to the structures and the process of data collection using 'Kobo Toolbox' mobile application. After the being enlightened about the procedure, the volunteers were divided into six (6) groups and they conducted survey under the supervision of the officials.

Figure 3. 2: Training of local volunteers from BNCC regarding the map updating process in Tangail Pourashava

3.4.5 Field Verification and Updating of Spatial and Non-Spatial Data

To prepare contingency plan, the information of all the buildings are needed. It includes the information on buildings that are constructed, developed to higher storied or demolished since 2010. These are done through field survey. During field updating, spatial information (i.e. shape of structures, open space, waterbody) has been drawn at satellite updated Ward map and non-spatial information (i.e., type and use of structures) have been collected using developed checklist format at "KoBo Toolbox".

Once the field survey is completed, the GIS database was updated. The newly built structures of satellite updated map and those that are not even in the updated satellite maps were added in the GIS database. Buildings which no longer exist, were removed from the GIS database. In addition, data base was updated to edit the number of story and landuse of the buildings.

3.5 Primary Data Collection for Assessment of Seismic Exposure

In order to assess the seismic exposure of the study area two bore holes up to a depth of 30 meters were conducted in ward no 13 of Tangail Pourashava. Disturbed and undisturbed samples were also collected from different depths. Figure 3.4 shows the location of the bore holes. The locations were selected based on the geological data presented in the report of CDMP-II.

Microtremor tests have been conducted. Figure 3.5 shows the location of microtremor test at ward no. 13. Data have been collected using 5 velocity sensors each having 3 channels. The channels collected in data in North-South, East-West and Up-Down direction. For each sensor the X axis was aligned with North. Each sensor was placed 25 meters apart. Precautions were taken to avoid noises and vibrations from other external sources so that they do not hamper the recording of the ambient vibration. Figure 3.3 shows the setup of sensors at the filed.

Figure 3. 3: Setup of sensor for microtremor test

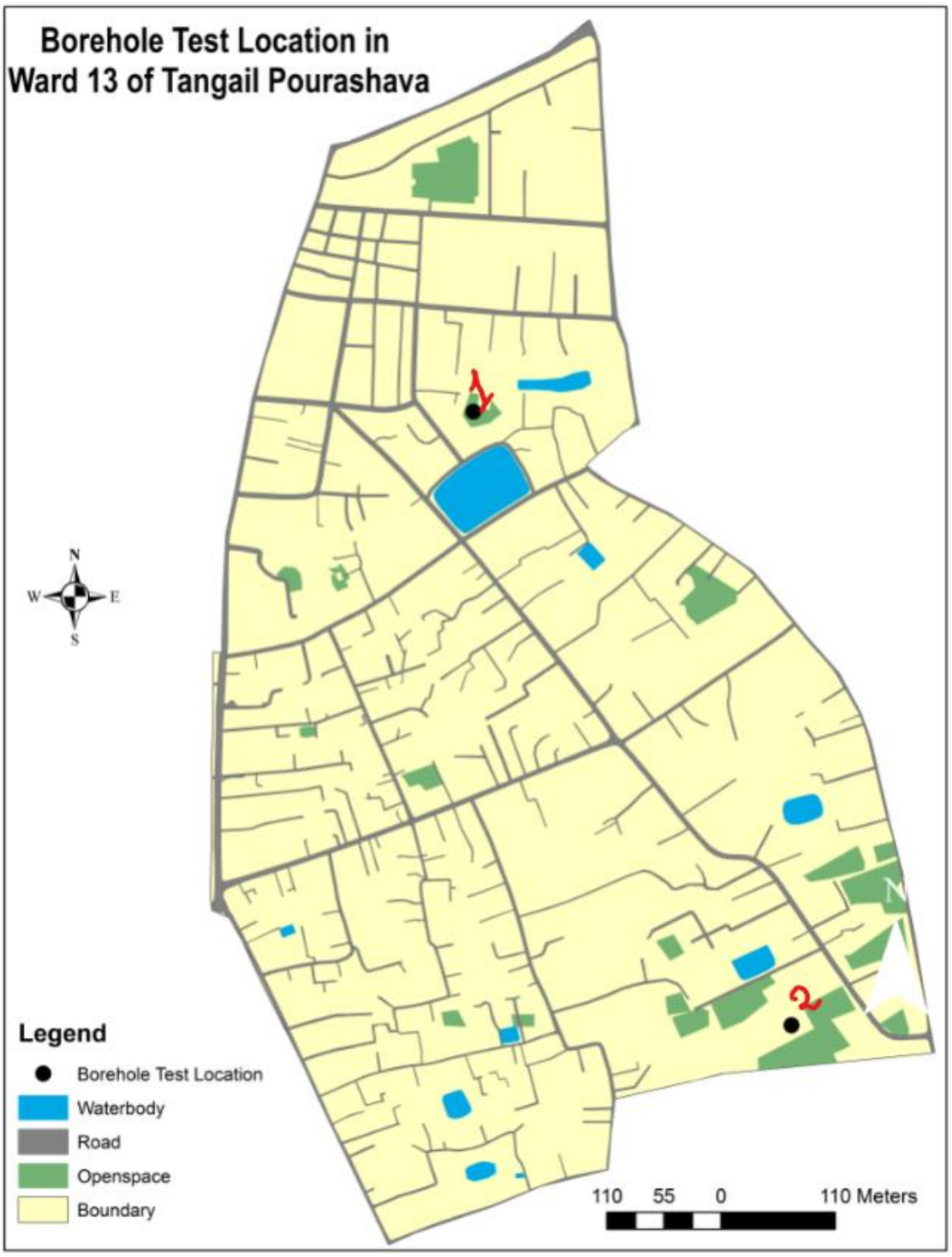

Figure 3. 4: Location of boreholes in ward no. 13 of Tangail Pourashava

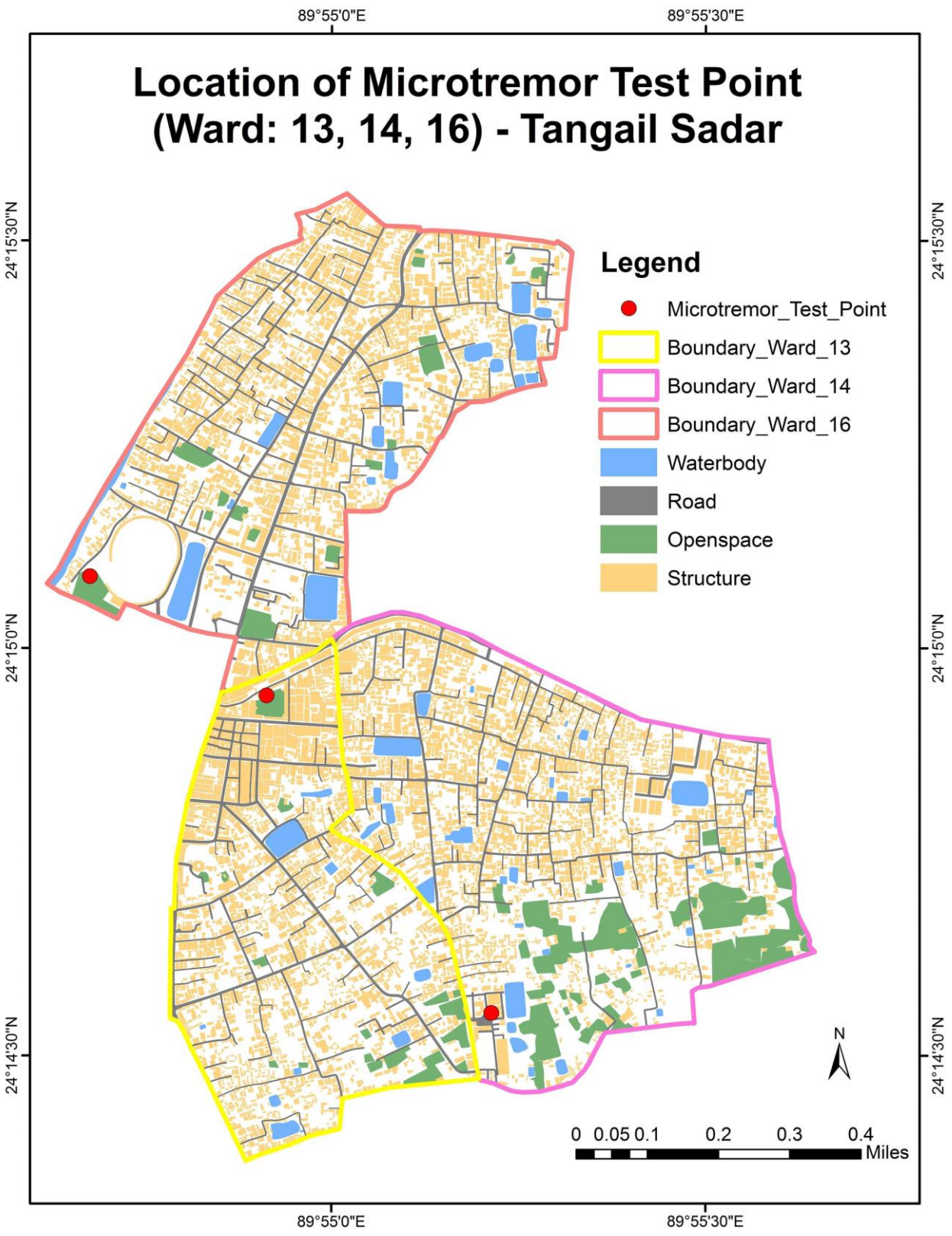

Figure 3. 5: Microtremor test location at Ward no. 13 of Tangail Pourashava

3.6 Data Collection and Vulnerability Assessment of Buildings

3.6.1 Survey for preliminary data collection of buildings

One of the first tasks of the project was to validate and update the database collected from secondary sources. For this, primarily a survey was conducted from December 3, 2019 to December 10, 2019. During this survey the previously prepared maps were verified. In this process the whole ward no 13 was divided into clusters and major information was collected regarding the features of the buildings (location, no. of storey, ownership, occupancy, type etc.). From the initial survey and updated maps, the latest number of buildings was determined. Table 3.2 shows the number of pucca buildings with respect to ownership and number of storey. Beside this there were 902 kutcha and semi-pucca buildings in the ward.

Table 3. 2: Total number of buildings in Ward No. 13 of Tangail Pourashava

Type of Structure	Ownership Status of Buildings				
Pacca	Private Buildings			Public Facilities Buildings*	
	1-3 Storey	4-6 Storey	6+ Storey	1-3 storey	3+ storey
	459	111	28	19	4

*All the government service office, hospitals, educational institutes were labeled as Public facilities buildings.

3.6.2 Preliminary Vulnerability Assessment of Buildings

To assess the buildings of the study area, two methodologies will be used: RVS (Rapid Visual Screening) suggested by FEMA (Federal Emergency Management Agency, USA, 2017 edition) for preliminary assessment and DEA (Details Engineering Assessment) for ten (10) buildings. Already we have conducted the Rapid Visual Screening process of the buildings located in ward no. 13.

Rapid Visual Screening (RVS): FEMA 154 was developed by ATC (Applied Technology Council) under contract to FEMA. The purpose of FEMA P-154 was to provide a methodology to evaluate the seismic safety of a large inventory of buildings quickly and inexpensively, with minimum access to the buildings, and determine those buildings that require a more detailed examination (FEMA, 2017). It is a sidewalk survey process that enables to classify the surveyed buildings into two categories: those as to the risk to life and those that may be seismically hazardous and should be investigated in more details by a design professional experienced in seismic design.

3.6.3 Checklist Preparation for RVS

As already mentioned, preliminary assessment of the vulnerability of the buildings was done following the guideline provided by FEMA 2017 edition. According to this level 1 survey has been performed. In order to get a clear idea about the buildings subjected to visual screening FEMA has a recommended form. We have developed a digital checklist by keeping the features of the form suggested by FEMA. We have used a tool named "Kobo Toolbox" to prepare the checklist. This includes the building identification information, picture of building, information of use, floor area, number of story as well as some pertinent data related to seismic performance e.g. vertical irregularity, seismic force resisting system, structural materials of the buildings, plan irregularity, pounding potential and the effect of surrounding structure, geological features on the site, non-structural hazards etc.

3.6.4 Sampling of buildings

The stratified sampling method was used for selection of samples. At first the whole ward was divided into 12 zones. There were two sets in the sample, public facility buildings and private buildings. All the public facility buildings (e.g. government offices, educational facilities, religious facilities and health facilities) irrespective of their storey height were made a part of the sample size. There are 23 such buildings in ward no. 13. For the second set, e.g. the private buildings, number of samples were proportionately distributed among the 12 zones. Initially private pucca structures of 4-storeys and above were selected for RVS. A total of 139 buildings were selected to be surveyed in ward 13 for preliminary vulnerability assessment of buildings. Table 3.3 shows details of the number of samples. Table 3.4 shows the number of samples in each zone. However, in the field, 48, one to three story private buildings were also surveyed in order to see their performance.

Table 3. 3: Sampling of private and public facility buildings

Study Area	Private buildings (pucca)			Public Facility buildings (pucca)		**Total**
Tangail	1-3 Storey	4-6 storey	6+ storey	1-3 storey	3+ storey	
Ward No. 13	**48**	**111**	**28**	**19**	**4**	**210**

Table 3. 4: Number of samples in each zone

Zone No.	Sample Size
1	26
2	31
3	21
4	27
5	15
6	23
7	17
8	12
9	15
10	7
11	11
12	5

3.6.5 Training Program

Before starting the field work of rapid visual survey, a training session was arranged for the local volunteers who would conduct the survey. The training took place on January 25, 2020 at the Conference room of Tangail Pourashava.

The training program consisted of two sessions. In the first session there was a formal inauguration. This was followed by a brief summary of the project and the objective of the work. There were 18 volunteers who would perform the RVS. After the summary they were divided into 9 groups. At first a brief description about the Rapid Visual Survey was presented. They were made familiar with the "Kobo Toolbox" and the checklist. Each question was explicitly described, and its importance was also stated. They were provided with both soft copies and hard copies of the checklist along with supporting documents which carried details about specific questions. The session was interactive, and the surveyors were made familiar with the theoretical background of the process.

3.6.6 Data Collection

Total 18 people volunteered for the purpose of data collection and they were students of Civil Engineering of local Polytechnic Institutes. They had a sound theoretical background and were also familiar with the locality. The volunteers were divided into 9 groups, each comprising of two members. A team leader was directly supervising three individual groups. The team leaders were from BUET-JIDPUS. The groups worked in their designated zones and surveyed the buildings. The data collection stared from 26 January and was completed on 3 February, 2020. Figure 3.3shows the volunteers during the survey.

Figure 3. 6: A group headed by a technical person during field-work

3.7 Social Survey

3.7.1 Questionnaire Preparation

A questionnaire was prepared for the assessment of socio-economic vulnerability and the preparation of contingency plan. While preparing the questionnaire the following issues were taken into consideration: the general information of the respondent and household, respondent's awareness, knowledge and perception on earthquake, respondent's ideas about Earthquake Disaster Management, and owner's consent to Earthquake Risk Reduction. A tentative questionnaire has been developed to conduct the household survey for social vulnerability assessment. To check the consistency and identify the complexities or gaps of the questionnaire, piloting of the questionnaire was conducted and tested in the area. After the piloting, the questionnaire was finalized (Appendix A). The team members were trained to understand the questionnaire. Once the members of data collection team understand the questionnaire, they started the survey under the supervision of cluster leader. The findings from this piloting helped to develop the final questionnaire of social survey and to develop the mechanism of social surveying.

3.7.2 Sampling of Buildings for Household Survey

Total 213 buildings were fixed as sample for household survey for ward 13 of Tangail Pourashava. Among the 213 buildings, it was fixed that in 150 buildings owner of the household would be surveyed (Table 3.5) and the rest would be surveyed for tenants.

According to the contract between DDM and BUET the total sample size for the study would be 2000. Considering the human error in data collection process, BUET team decided to collect data from 2200 households. However, as high-rise buildings are more vulnerable to earthquake, all residential buildings which are four storied or higher were taken into consideration in the sample size; the total number of buildings falling in this category was 1290 for Rangpur City Corporation and the three pourashavas. The remaining 810 residential buildings would be selected from kutcha and semi pucca and one to three storied residential buildings following the theory of proportional sampling method. The proportion was considered as district level, then within a district as ward level, subsequently within a ward as cluster level. Ward 13 of Tangail Pourashava was divided into 12 small clusters so that attributes (like: structure type, number of story) of every building can be shown in A4 size maps and that helped the surveyors to find out any specific building which was sampled/marked. Cluster map for Ward no 19 is shown in Appendix B.

Table 3. 5: Sampling for household survey in Ward 13, Tangail Pourashava (owner)

Cluster No.	**1 to 3 Storied buildings**	**4 to 6 Storied buildings**	**6+ storied buildings**	**Kutcha or Semi pucca**	**Total**
Cluster 1	0	11	3	1	**15**
Cluster 2	0	14	4	1	**19**
Cluster 3	1	6	0	1	**8**
Cluster 4	1	9	1	1	**12**
Cluster 5	1	9	0	1	**11**
Cluster 6	1	11	2	1	**15**
Cluster 7	2	12	0	4	**18**
Cluster 8	1	5	0	3	**9**
Cluster 9	2	8	1	4	**15**
Cluster 10	1	2	0	3	**6**
Cluster 11	2	8	0	4	**14**

Cluster 12	1	3	0	4	**8**
Total	**13**	**98**	**11**	**28**	**150**

Table 3. 6: Sampling for household survey in Ward 13, Tangail Pourashava (tenant)

Cluster No.	**1 to 3 Storied buildings**	**4 to 6 Storied buildings**	**6+ storied buildings**	**Kutcha or Semi pucca**	**Total**
Cluster 1	0	4	1	0	**5**
Cluster 2	0	6	1	0	**7**
Cluster 3	0	3	0	0	**3**
Cluster 4	0	4	1	1	**6**
Cluster 5	0	4	0	0	**4**
Cluster 6	1	5	1	1	**8**
Cluster 7	1	5	0	1	**7**
Cluster 8	1	2	0	1	**4**
Cluster 9	1	3	1	2	**7**
Cluster 10	0	1	0	1	**2**
Cluster 11	1	3	0	2	**6**
Cluster 12	0	1	0	1	**2**
Total	**5**	**42**	**5**	**11**	**63**

In the next phase of structural vulnerability assessment, sometimes retrofitting of vulnerable buildings would be proposed according to the consent of building owners. Paying attention to this very issue, seventy percent sample was considered from owner household of a residential

building. While to get a comprehensive scenario, the remaining was taken from the tenant. This proportion was also maintained in each level i.e. district, ward, cluster mentioned earlier.

In ward-13 of Tangail Pourashava, the total sample size is 213 (150 owner household and 63 tenant household). Of these, 156 households would be taken from four storied or higher, 18 households from one to three storied and 39 households from kutcha and semi pucca residential buildings.

3.7.3 Training Program to Conduct Household survey

On 25th January, 2020, the training program was started at approximately 10:30 AM. at Tangail Pourashava (Figure: 3.8). In this training program, there were two sessions. The activities under the first sessions were to render information, motivation and importance of the project to the volunteers so that they could own the project. In the second session, an interactive conversation was conducted to discuss and learn the contents of the questionnaire. The other activities in the second session was about how to interpret the maps and how to enter the information of Household (HH) at "KoBo Toolbox".

Figure 3. 7: Training Program to Conduct Household Survey in Tangail Pourashava

3.7.4 Data Collection

Household questionnaire survey was conducted from 30th January, 2020 and 2nd February, 2020 in the selected buildings according to the sampling in ward 13 of Tangail Pourashava. The survey was conducted by total 9 groups each consists of two members (1 Female and 1 Male). One survey supervisor was assigned for every three groups for quality control.

Figure 3. 8: Data Collection-Household Survey in Ward 13

3.10 Socio-Economic Vulnerability Assessment

Once the questionnaire survey was over, data were exported from Kobo Toolbox as an excel spreadsheet. Total 185 household questionnaires were found for the ward 13 which is less than the fixed sample. This scenario happened because a number of buildings could not be surveyed as no residential use was found in those buildings. Therefore, further analysis had been performed on the basis of the data from these 185 households. The socio-economic issues include issues like age, sex, educational level, occupation, household income, physically or mentally challenged people, house ownership etc. and the perception of the community regarding earthquake was included in the survey. Statistical analysis based on several variables had been performed to understand the socio-economic context of the study area and the rest of the analysis will also be performed very soon.

3.11 Contingency Planning for Earthquake

Based on building and socioeconomic vulnerability of the study area, an earthquake contingency plan is expected to be prepared for the study area. The contingency plan would include five components. They are:

• Ward Co-ordination Center planning at Ward level considering community-based disaster risk management;

• Temporary Shelter Planning

• Emergency Health Facility Planning

• Evacuation Route Planning; and

• Household level preparedness planning at household level

3.11.1 Temporary Shelter Planning

After an earthquake, it is expected that good number of people will be homeless due to collapse of buildings. It would be an urgent need to provide them shelter. Temporary dwellings constitute a crucial step of recovery and reconstruction in the post-disaster aftermath. It plays a vital role in order to provide protection to the affected people and provide a habitable environment while the outcomes of a disaster are being evaluated and then rectified (Donohue, 2012). Temporary shelter planning involves:

- Need Assessment
- Availability of Space Assessment
- Estimation of Ancillary Facilities for Temporary Shelter
- Allocation of Space to the needy

a) Need Assessment:

After a severe earthquake, occurrence of several aftershocks can be seen in the same area of main shock. Some structures that may sustain the main shock may not sustain the aftershocks (World Bank Institution, 2012). Additionally, as a result of aftershocks people may not prefer to return their buildings which are not damaged (World Bank Institution, 2012). In this context BUET team developed two scenarios in this research. The scenarios and their corresponding assumptions for estimating demand are:

Scenario 1: The residents of buildings which are damaged or collapsed would need shelter. So households living in these residents are considered for temporary shelter.

Scenario 2: All of the residents in the study area will require temporary shelter.

b) Available Space Assessment:

In Japan, large-park or open space, playground, religious and school buildings and spaces in public buildings are considered to provide shelter in after math of an earthquake (Xu, Okada, Hatayama, & He, 2006; World Bank Institution, 2012) while after 2015 tents in open spaces were used in Nepal as temporary shelter (Sheltercluster.org, 2018).So for temporary shelter, open space, playground, religious and school buildings and spaces in public building have been considered. Initially, all the public building was considered as possible place for temporary shelter in addition to open space and playground. Then the buildings, which

deemed to be structurally unsafe by RVS will be removed from calculation. It is expected that, in the upcoming workshop participants will verify these places of temporary shelters. Based on their feedback, final selection of the temporary shelters will be done. Once space for temporary shelter is identified, capacity of each of the shelter will be calculated.

c) Estimation of Facilities in Temporary Shelters:

Temporary shelters need to meet the need of the people staying in the shelters after an earthquake. So there is need for toilet, water and first aid treatment facility etc. This will also be estimated.

d) Allocation of Space to the homeless

The study would try to accommodate people of same cluster together. So, cluster-wise need as well as space would be calculated. If there is shortage of space, then it would try to put people in closest shelter of the adjoining cluster of the ward. If there is shortage of space in the ward, then space from the nearest cluster of the nearest ward would be used.

3.11.2 Health Facility Planning

The collapse of structural buildings due to earthquake may result in death and severe injury to the people of the study area. Emergency health facilities will be required to minimize the sufferings of the injured people after an earthquake. Like temporary shelter planning it would follow a step process:

- Need Assessment
- Estimating availability of Space for providing medical support
- Estimation of support facilities to run medical support

a) Need Estimation:

There would be death and injury after an earthquake. According to CDMP (2009b) there would be four injuries to people with four different level of severity after an earthquake. They also estimated the probable ratio of injury of population at different severity level. From this, the need of emergency health facility will be estimated.

b) Estimating Availability of Space for providing medical support:

The Existing hospitals, clinics and diagnostic centers had been identified with their location and area (space) and considered primarily for providing medical facility after earthquake in the study area. The facilities located in structurally safe building by RVS will be identified as possible health facility. After that, in the workshop participants will verify the health facilities. Based on their feedback, final selection of the health facilities will be done.

c) Estimation of Support Facilities to run Medical Facilities:

As all the identified health facilities are now operating as health facility, so it is logical to assume that they have the necessary support infrastructure. However, in the aftermath of an earthquake these facilities have to support more than their designed population. So, this estimation also has to be done according to standards.

3.11.3 Evacuation Route Planning

Evacuation route is an escape designated to a facility (temporary shelter, hospital etc.) in an emergency situation, such as a fire or earthquake (CollinsDictionary.com, 2018). Evacuation route planning is a complex process consisting of several consecutive phases. After the detection of potential disaster, it is necessary to evaluate the potential threat for specific areas and then issue an evacuation order for these areas for the vulnerable area to a safe place to provide adequate protection to the residents and others. Evacuation planning is influenced by the condition of infrastructure of the affected area to ensure the accessibility to the safer place. Following steps will be followed to determine evacuation route:

(a) Identifying Vulnerable Building:

Buildings which have an RVS score 1.2 or less is considered as vulnerable. It is assumed that debris from the collapsed building would partially or fully block the road considering different contexts

(b) Determining Blockage in the Road:

It should be mentioned here that as data of all buildings were not collected some roads which the maps show unblocked may be blocked if the height of the building is greater than the road width. However, we do not expect such thing would happen as we collected data for all buildings higher than three storied and most of the three storied building. And it is for two storied and lower there would higher probability of in situ collapse than collapsing on the road. . So for identifying blockage, the height of each storey of building is considered 10 feet.

Based on the width of the road in front of the building the road would not be blocked, partially blocked or fully blocked.

(c) Accessibility of the Open Roads:

Once the blocked roads are identified the rest of the open roads will be considered based on their accessibility considering road width. The routes will be classified in some groups.

(d) Identifying Evacuation Route:

Based on road blockage and accessibility, the evacuation route map will be prepared. This route will be usable for the evacuees to move to the temporary shelters, to take the injured people to the health facilities and to connect the temporary shelters and the health facilities with the Ward Co-ordination Center.

3.11.4 Ward Co-ordination Center Planning

Ward Co-ordination Center is required during disaster in order to ensure proper mobilization and management of personnel, necessary equipment and supplies immediate after an earthquake. In identifying Ward Co-ordination Center following will be considered

• the facility should be in a government building,

• should be structurally safe and

• should be centrally located and easily accessible

3.11.5 Institutional Management Plan

An institutional arrangement is needed for proper functioning of temporary shelter, health facility and Ward Co-Ordination Center. So institutional management plan has been developed which would connect the temporary shelter, health facilities and Ward Co-Ordination Center to Tangail Pourashava. Requirement of volunteers will also be estimated thereby for the management of the facilities. Criteria for selecting members have been fixed.

3.11.6 Household Preparedness Planning

To ensure proper preparedness for earthquake at household level, a plan would be developed guiding different preparedness activities. The household preparedness plan is based on Household Preparedness Plan prepared in Philippine but considered the local context.

3.12 Finalization of the plan at Local Workshop

It should be mentioned here that this is an initial contingency plan. It is expected that the plan would be revised once all data is process. It is expected that before finalization of the plan,

the draft plan is prepared it will be shared with local community. In the workshop, according to the suggestions from the community, some changes regarding temporary shelter, health facility and evacuation route which will be incorporated. The Ward Co-ordination Center can also be changed on their suggestion as happened in Mymensingh. Additionally, the participants may identify some road blocks to ensure proper evacuation after an earthquake. Based on their feedback, the evacuation route plan will be finalized and some recommendations will be developed to remove the identified road blockage. This local workshop will be participated by the Honorable mayor of Tangail Pourashava, officials from Tangail Pourashava, officials from UNDP, Ward Councilor of Ward no.13, representatives of different groups of community of Ward no. 13, members of civil society, earthquake volunteers of Ward no. 13 and other representatives from Ward no. 13.

3.13 Final Report Preparation

Once the local workshop is concluded, the final report will be prepared. The report will contain not only the result of the study with appropriate figures, maps and tables but also recommendation to reduce the vulnerability of the community.

CHAPTER 4: SEISMIC EXPOSURE ASSESSMENT

4.1 Introduction

This chapter deals with the borehole location and results of microtremor analysis for Ward no. 13 of Tangail Pourashava. It will help us to know the local soil condition and local seismic effect.

4.2 Borehole Data (SPT value and Description of Soil)

Figure 4.1 and Figure 4.2 represent the bore logs of the two bore holes of Ward 13 of Tangail Pourashava. One boring (Bore Hole 1) was done at Zone 4 and another boring (Bore Hole 2) was done at Zone 11. Bore hole diameter, used in these tests was 100 mm. Both disturbed and undisturbed samples were collected from the borings. 20 readings of SPT-N value at 1.5m interval up to 30 m were taken. Point to be noted in this regard that, SPT value indicates the strength of soil.

The soil profile of bore hole 1 shows four different layers of soil. From the N value, it was observed that up to 10.5m, the readings were less than 10, which means upper layers of soil has lower strength compared to the bottom layers where the readings were approaching 50. The detailed description of the soil type has been shown in Figure 4.1.

On the other hand, the soil profile of bore hole 2 shows two layers of soil. It was observed that up to 7.5m, the N values were less than 10 and the bottom readings were approaching 50. So, the depth of soil layer with less strength is smaller here than compared to that of bore hole 1.

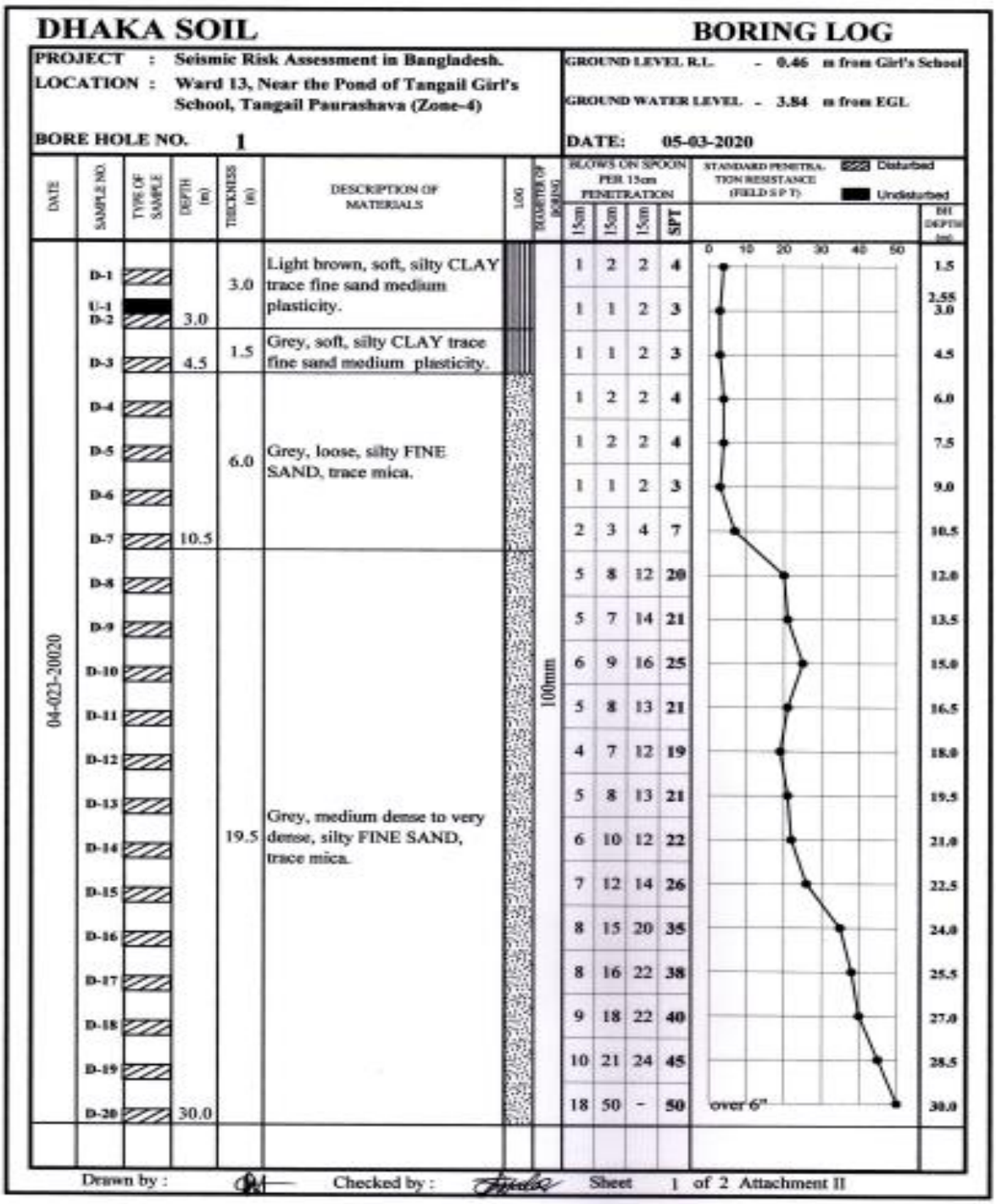

Figure 4. 1: SPT data of Bore Hole 1

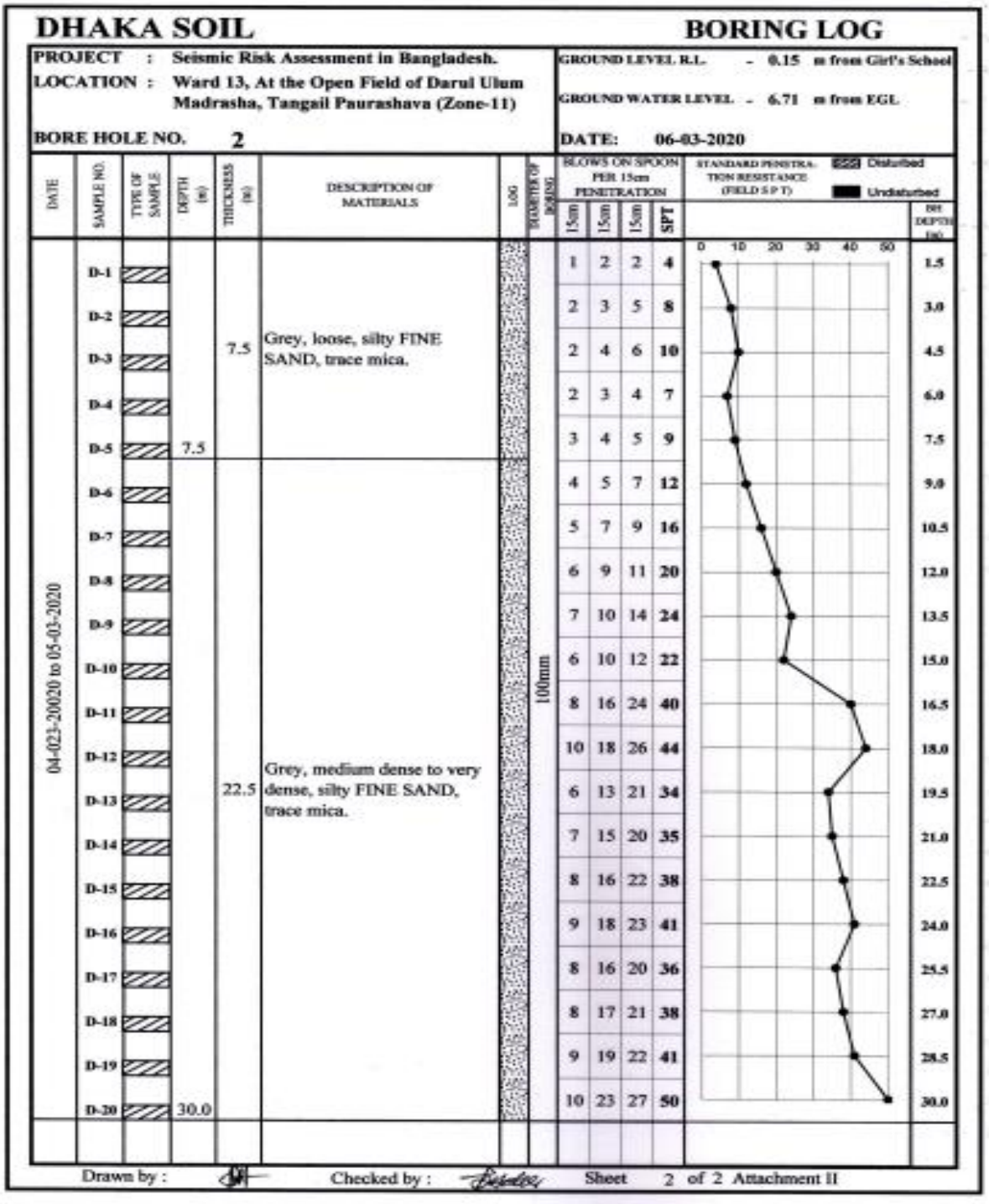

Figure 4. 2: SPT data of Bore Hole 2

4.3 Microtremor Test

Microtremor test was conducted at one location of ward no. 19 of Tangail Pourashava. The methodology has been stated in article 3.5 of Chapter 3.

Microtremor Analysis of Ward no. Ward no. 13 of Tangail Pourashava

Figure 4.3 shows the Amplitude vs Frequency graph for Ward 13 of Tangail Pourashava. From the graph we can observe that the amplitude is maximum at 1.3 Hz. So, the predominant frequency is around 1.3 Hz. Using empirical equation, the shear wave velocity of the 30 meter 1-D soil column was found to be around 156 m/s.

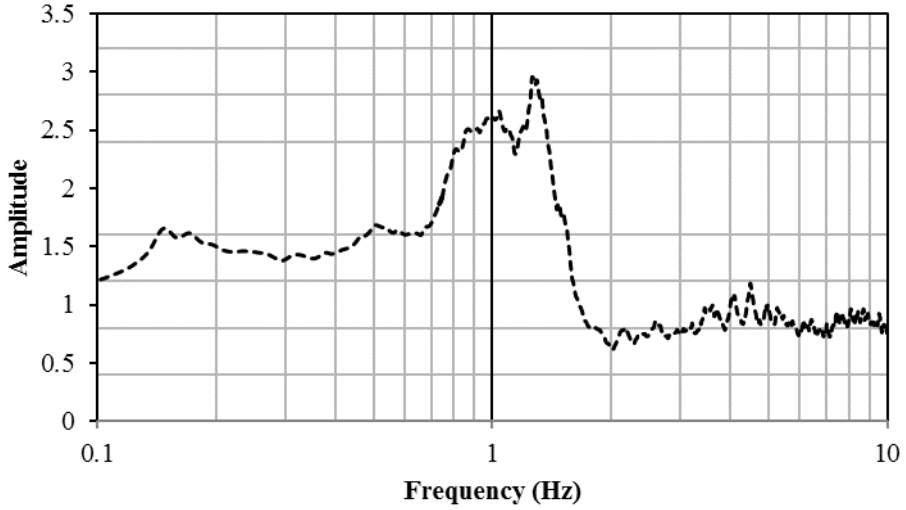

Figure 4. 3: Amplitude vs Frequency graph of Ward no. 13 of Tangail Pourashava

CHAPTER 5: BUILDING VULNERABILITY ASSESSMENT

5.1 Introduction

In this chapter, the seismic vulnerability of the buildings of Ward No. 13 of Tangail Pourashava has been discussed on the basis of Rapid Visual Screening of 210 buildings.

5.2 Preliminary Assessment using Rapid Visual Screening

The seismic vulnerability assessment of structures in the selected area has been done by RVS (Rapid Visual Screening) method formulated in FEMA P-154. In this method, the main focus was on earthquake issues such as identifying building type, plot size and shape, clear distances from surrounding structures, road width and basic information of the building: year of construction, number of storey, overhang, vertical irregularity, plan irregularity etc. Digital photographs of each building from at least two directions were taken.

5.3 Results and Discussion of Preliminary Vulnerability Assessment

In this section, results of the analysis are presented focusing on the main concerning point of the structure.

Table 5.1 shows the number of the total surveyed buildings of all 12 zones of Ward no 13 of Tangail Pourashava. It has been observed that the final score of 65% of the total surveyed buildings were below cutoff (1.2) and thus these are vulnerable. Zone 5 has the lowest percentage (20%) of vulnerable buildings. Zone 6 has the highest percentage (83%) of vulnerable buildings.

It was found that among the 210 surveyed buildings, 197 buildings are Concrete frame with unreinforced masonry infill walls (C3) and only 13 of them are Concrete shear wall buildings (C2). Figure 5.1 shows the percentages of the different building types.

Table 5. 1: Percentage of vulnerable buildings in different zones

Zone	Number of Building Surveyed	Number of Vulnerable Buildings	Percentage of Vulnerable Buildings
1	26	15	58%
2	31	25	81%
3	21	12	57%
4	27	14	52%
5	15	3	20%
6	23	19	83%
7	17	14	69%
8	12	8	82%
9	15	10	67%
10	7	5	71%
11	11	8	73%
12	5	3	60%

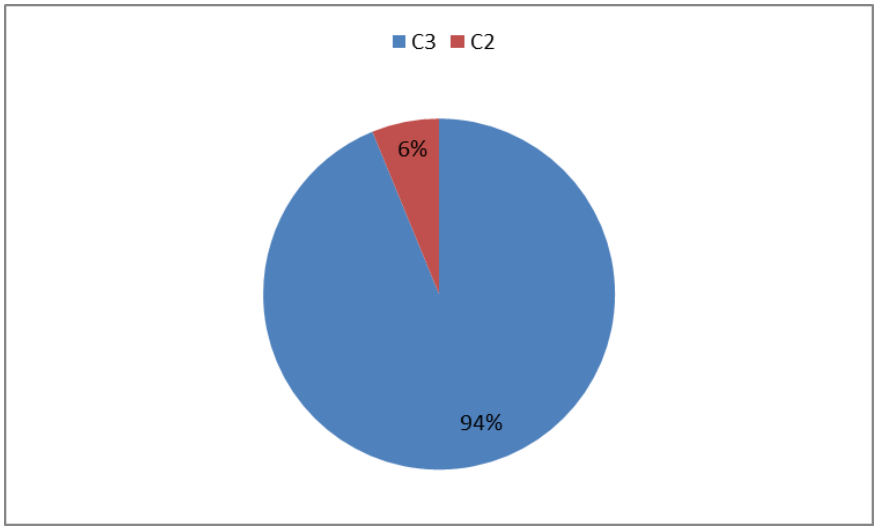

Figure 5. 1: Building Classification percentage

Figure 5.2 represents relation between number of buildings and severe vertical irregularity which included any or all of the stated: short column, soft story/weak story and out of plane setback. It has been observed that 49% of the buildings which were surveyed had severe vertical irregularity. Figure 5.3 represents relation between number of buildings and moderate vertical irregularity (e.g. in plane setback, sloping site, split level). We saw that only 4% of the buildings had moderate vertical irregularity.

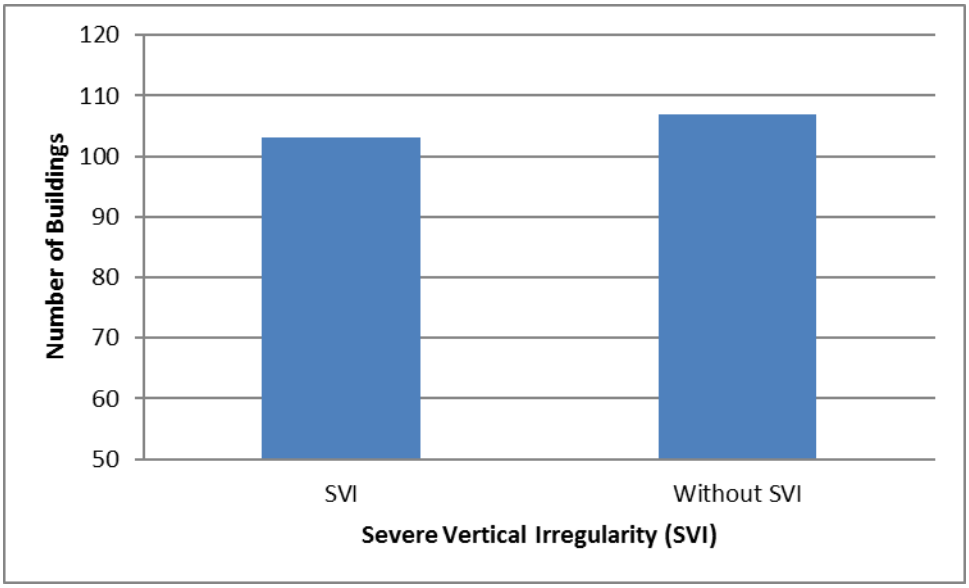

Figure 5. 2: Relations between Number of buildings and Severe Vertical Irregularity

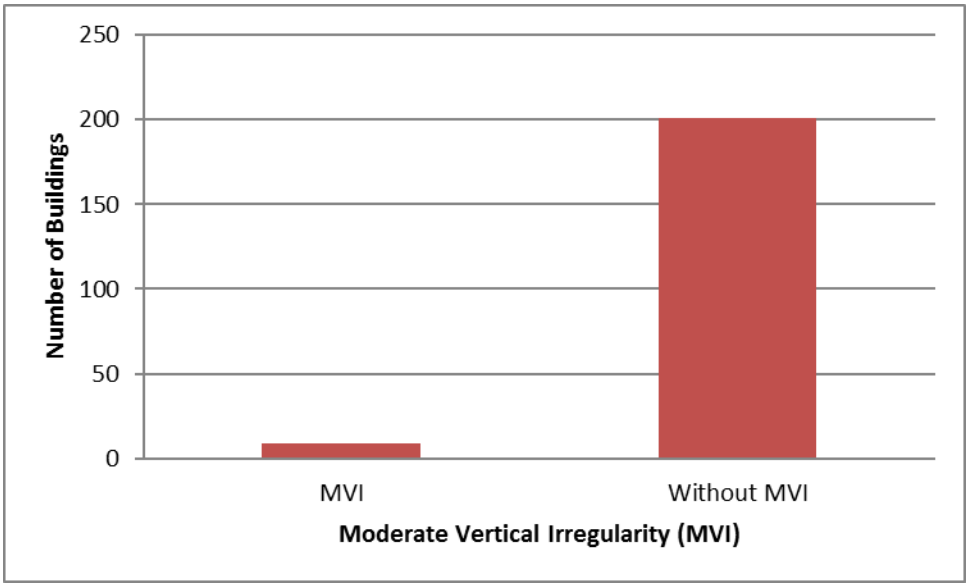

Figure 5. 3: Relations between Number of buildings and Moderate Vertical Irregularity

Figure 5.4 represents relation between number of buildings and plan irregularity (e.g. torsional irregularity, non-parallel system, reentrant corner, diaphragm opening, out of plane offset). 39% of the buildings had shown plan irregularity.

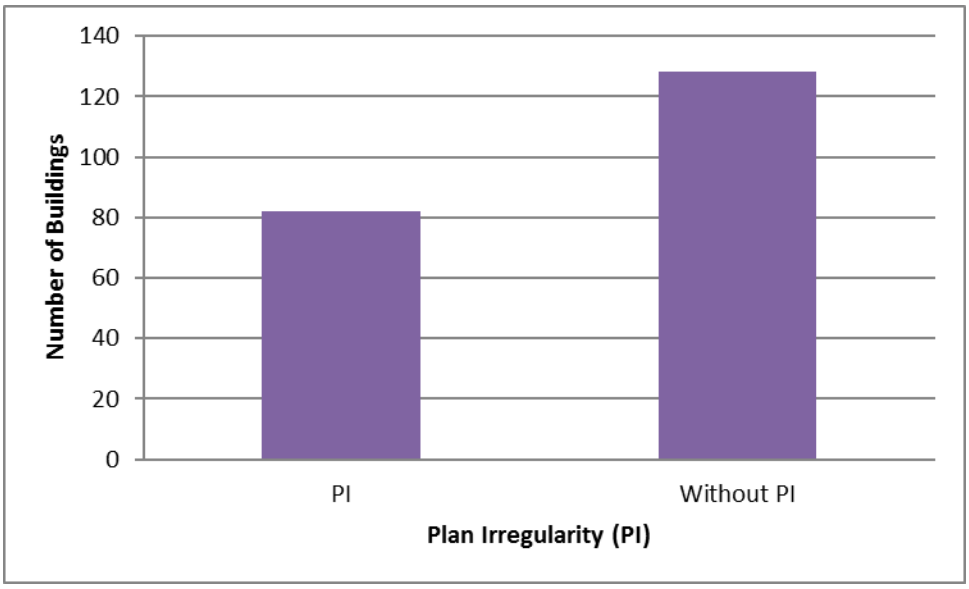

Figure 5. 4: Relations between Number of buildings and Plane Irregularity

Figure 5.5 represents relations between number of buildings and the RVS score. This figure indicates that 25% of the buildings has a score less than or equal 0.3, 43% of the buildings has a score between 0.4 to 0.6, 15% of the buildings score in between 0.7 to 0.9, 4% of the buildings has score in between 1 to 1.2, 34% of the surveyed buildings has score in between 1.2-1.4 and finally 1% of the buildings has score greater than 1.4.

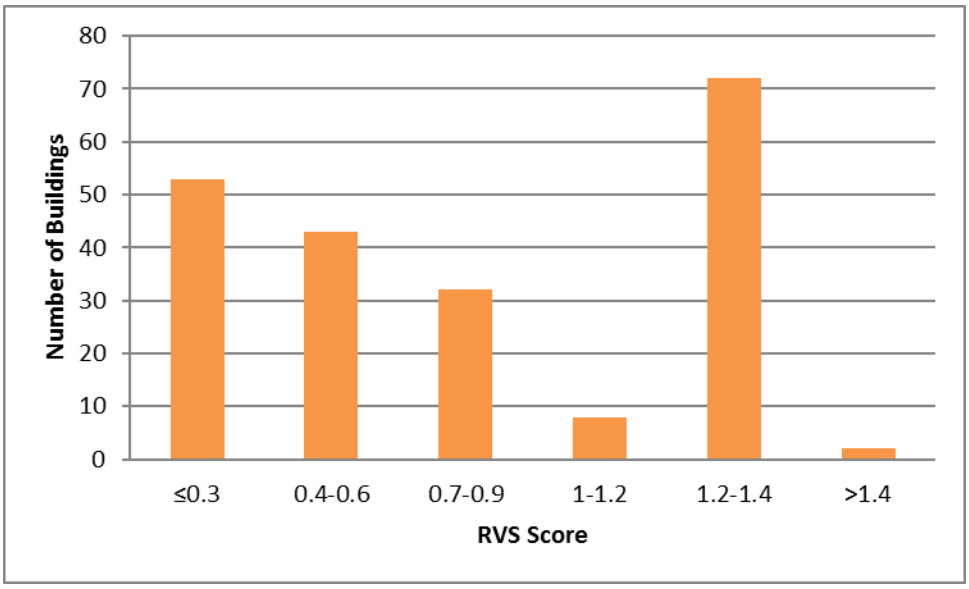

Figure 5. 5: Relations between Number of buildings and RVS Score

Figure 5.6 shows the relation between numbers of buildings and number of storey. From this figure, it is clear that 4 storied building are predominant in the surveyed area and it is about 30% of the total sample size of ward no. 13. The second dominant type are the buildings with 5 stories and they are 19%. Percentage of 3 storey buildings is 16%. Only 18% of the surveyed buildings fall within the storey range of 6 to 13.

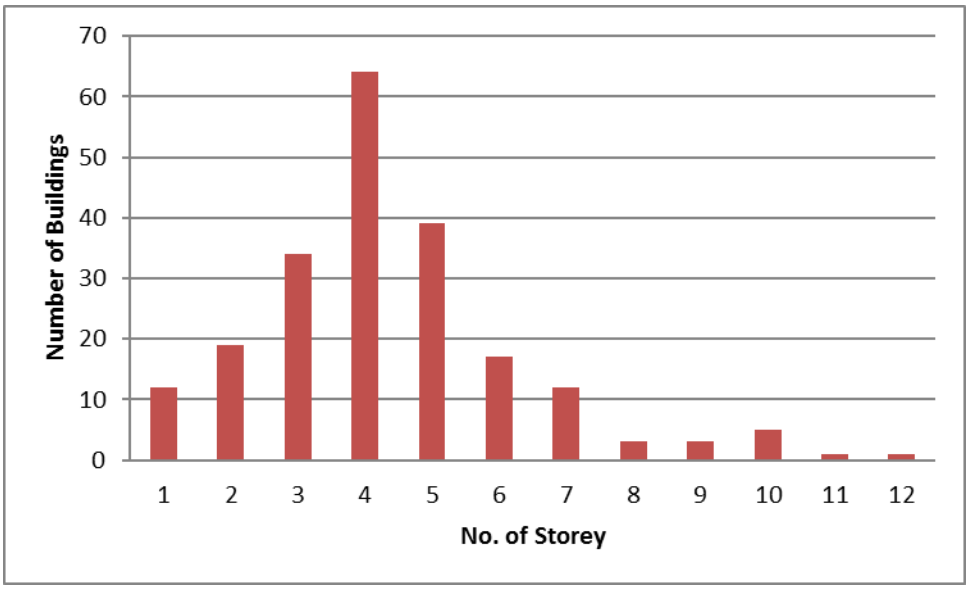

Figure 5. 6: Relations between the number of buildings and no. of storey

CHAPTER 6: SOCIO-ECONOMIC VULNERABILITY ASSESSMENT

6.1 Introduction

Socio-economic vulnerability of a community is defined as the condition of a community which have unequal participation in decision making process, weak or no community organizations; discriminative economic standard, social norms and values, political accountability, variation of income and production etc. (Mnestudies.com, 2018). It examines social and economic factors for better understanding of the how the combination of both influences an area of interest or study (Brouwer, 2018). A disaster like earthquake does not only damage or destroy buildings and infrastructures, but cause damage and destruction of centers of economic, cultural and social activities. By causing massive destruction to individual buildings, critical facilities, or economic and cultural centers, earthquake disturbs or destroys the existing inter-relationship and interaction between or among the different groups and activities of a society or a nation (ADPC, n.d.). Socio-economic vulnerability is greatest among the poorest people in developing countries because of lack of information and resources with in order to take the appropriate measures. Within this group, children, women and the elderly are considered to be the most vulnerable. To reduce such vulnerability, it is necessary to identify the knowledge and understanding of the local residents (Mnestudies.com, 2018). This chapter focuses on the analysis of socio-economic vulnerability of Ward No. 13 of Tangail Pourashava. The socio-economic issues considered here include general profile of the respondents and their family members (age, sex, educational qualification, occupation, house ownership, earthquake training, data of physically challenged people etc.), perception regarding earthquake risk, perception about earthquake preparedness and their eagerness to get involve with these type of volunteering works etc. The analysis has been done on the basis of household questionnaire survey of 185 households which includes total 720 members.

6.2 General Socio-economic profile of surveyed population

To understand socio-economic profile of the study area, gender and age composition, occupation, education level and physical disability status of total 720 members of 185 households were analyzed. Additionally, monthly household income of 185 households were also analyzed.

6.2.1 Gender and age composition

Data of 720 individuals of 185 surveyed households who live in Ward 13 of Tangail Pourashava were collected for the study through the method described in Chapter Three. It has been observed that distribution of male and female is very close and almost equal. So, there is no scope to exclude any gender group rather, special needs and requirements of both groups must be incorporated in different disaster management activities so that they can response in the case of any disaster.

Table 6.1 shows the distribution of the members from surveyed household of Ward 13 according to their age group. For the convenience of analysis, the members of the surveyed households have been divided into five age groups, i.e. children (<10years), young (11-20 years), young adults (21-30 years), middle aged (31-60 years), and elderly (>60 years). From table 6.1, it is visible that, highest percentages (61%) of the inhabitants of the surveyed households are belongs to age group 21-60. It is also necessary to note that a significant share of the members are children (11%) and elderly people (13%), who will require assistance after an earthquake.

Table 6. 1: Distribution of respondents according to their age group

Age Group	**Number of residents**
Less than 10 years	79
11 to 20 years	106
21 to 30 years	147
31 to 60 years	297
More than 60 years	91
Total	**720**

(Source: Field Survey, 2020)

6.2.2 Occupation

Figure 6.1 shows the distribution of 720 members of the surveyed household according to their occupation. From the figure 6.2, it is visible that almost one third of the inhabitants (30%) of the surveyed households are students. So there is a wide scope to engage this group in disaster management activities through awareness building and proper training.

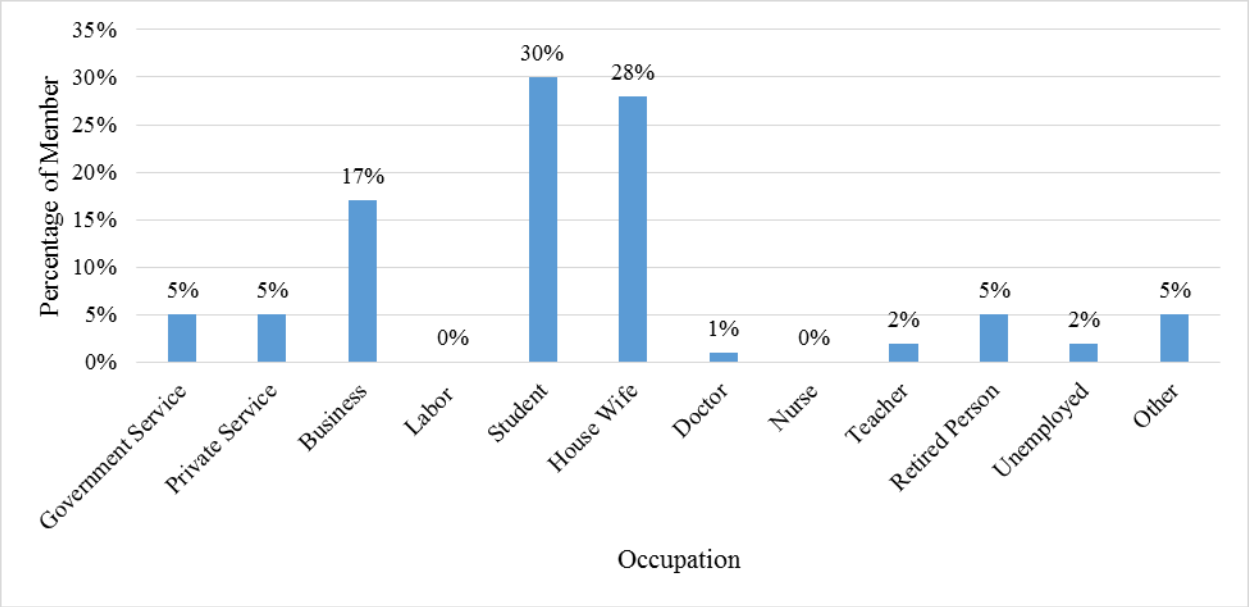

Figure 6. 1: Distribution of household members according to their occupation (Source: Field Survey, 2020)

6.2.3 Educational Qualification

The following Figure 6.2 shows the distribution of educational qualification of 720 members of 185 households of the ward. The highest percentage of the members of the surveyed households has educational qualification up to secondary level (24%) followed by higher secondary level (21%) and graduate level (21%). Only 6% of the inhabitants from the surveyed households are illiterate where the national illiteracy rate in Bangladesh is almost 40% (UNESCO, 2008).

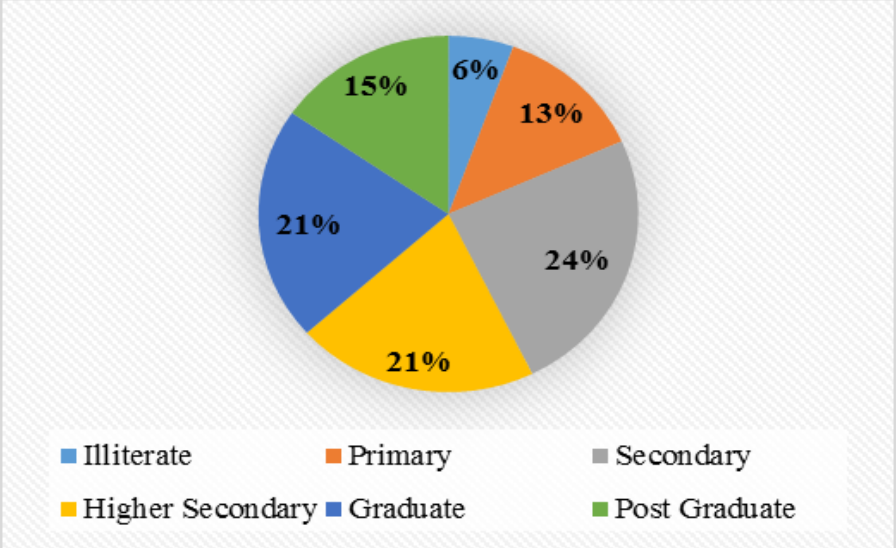

Figure 6. 2: Distribution of household members according to educational qualification (Source: Field Survey, 2020)

6.2.4 Physically Challenged Population

Physically challenged people would need assistance after an earthquake. It has been found from the survey that only 1.11% (8 out of 720 members) members from the surveyed households are physically or mentally disabled. Though the percentage is very low, still it is important to consider them to ensure proper earthquake response.

6.2.5 People Having Earthquake Training

Among 720 people of surveyed 185 households, only 3 residents were found who have some sort of training on earthquake. These people were trained from Fire Service and Civil Defense, Red Crescent, Scouting and school level earthquake drill.

6.2.6 Household Monthly Income

Monthly income of majority portion of the surveyed households (185 households) is less than 40,000 BDT (Figure 6.3). 17% household has monthly income of less than 20,000 BDT. More than 50,000 BDT per month is earned by 23% of the surveyed households.

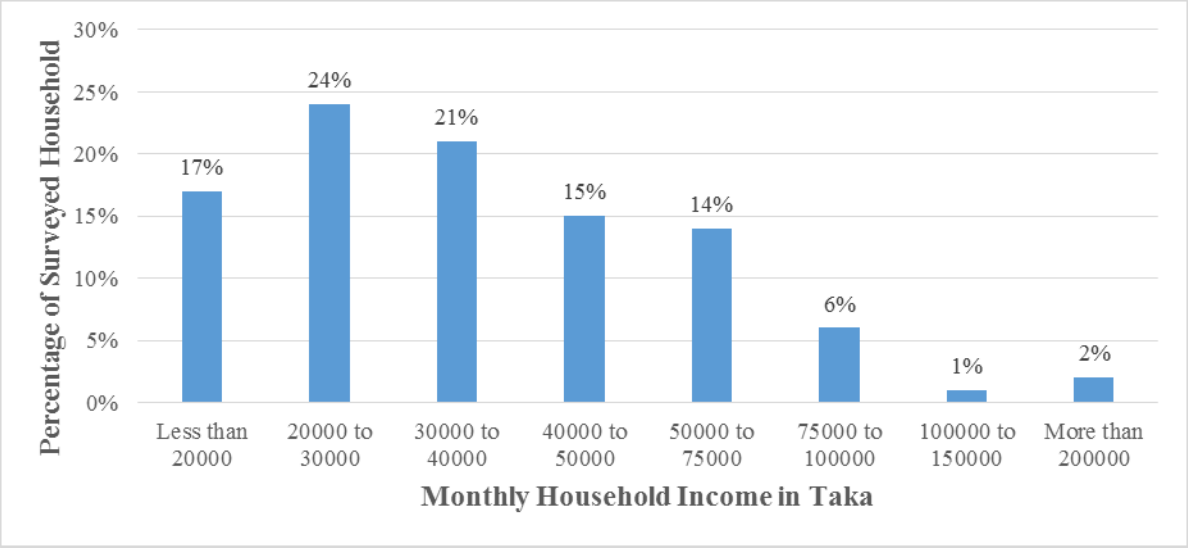

Figure 6. 3: Distribution of monthly household income of the surveyed household (Source: Field Survey, 2020)

6.3 Peoples' Perception about Earthquake Vulnerability of the Area

The respondents were asked if they are aware of the earthquake vulnerability of their district. Though Tangail is vulnerable to earthquake, only 41.08% (76 out of 185) responded that they are aware of this, which infers to the harsh truth that, majority of the respondents don't even know about the earthquake risk they are facing. The finding states 58.92% (109 out of 185) of

the respondents do not have any idea about the earthquake vulnerability of the area. They don't know the actual reasons and are not aware of the precautions that should be taken for earthquake resiliency.

6.4 Peoples' Perception about Earthquake Vulnerability of their Building

From previous discussion it is found that, 76 out of 185 (41.08 %) respondents know about earthquake vulnerability of the area. But when respondents were asked whether they know about the earthquake vulnerability of their own buildings, only 11.89 % (22 out of 185) of the respondents thought that they consider their buildings to be vulnerable to earthquake.

6.5 People's Eagerness to Participate in Disaster Management Activities

Participation of community people in any disaster related activities is necessary for effective disaster management plan. Community level participation helps integrating with national and international level complement which is very important to ensure proper management after earthquake. Almost 21.6% of the 185 respondents showed eagerness to get involved with the activities of disaster management committee of their ward.

CHAPTER 7: CONCLUSION

It should be bear in mind that contingency plan is neither a stand-alone document nor a static document. It should be an ongoing process integrated and coordinated with activities suggested by other documents. It is well understood that earthquake would cause damaged at regional scale. So, contingency plan at regional scale should be prepared. But the issue which bears the highest importance is to count the effect of an earthquake on spatial dimension at local level. Though CDMP (2014) prepared a contingency plan for Tangail Pourashava, importance was given on institutional activities and less focus on local level panning. Though the work on this ward is not completed yet, involvement of local level planning and community participation will be ensured in the next stages. However, for successful implementation of the contingency plan, this kind of plan needed to be prepared for the other wards of the municipalities.

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APPENDIX A

Questionnaire for Social Survey

টাঙ্গাইল পৌরসভা এর এলাকা ভিত্তিক ভূমিকম্প ঝুঁকি নিরসন এবং ব্যবস্থাপনা

প্রশ্নপত্র নম্বর _____ তারিখ _____

বিল্ডিং আইডি _____ ওয়ার্ড নং _____

প্রশ্নকারীর গ্রুপ_____ ক্লাস্টার নং _____

হোল্ডিং নং _____

১। উত্তরদাতার সাধারণ তথ্য

১.১ উত্তরদাতার নাম _____

১.২ আবাসিক ভবনের মালিকানা (√চিহ্ন দিন)

- সরকারী
- বেসরকারী (ব্যক্তিগত)
- বেসরকারী (যৌথ মালিকানাধীন)

১.৩ ভবনটি নির্মাণ এর সাল _____

২। পরিবারের তথ্য (আবাসিক ভবনের ক্ষেত্রে)

২.১ পরিবারে সদস্য সংখ্যা _____

২.২ পরিবারের সদস্যদের বিস্তারিত বিবরন

সদস্য ক্রম	বয়স	লিংগ	শিক্ষাগত যোগ্যতা	পেশা	প্রতিবন্ধী আছে কি ? (হ্যাঁ/ না) প্রতিবন্ধকতার ধরন	ভূমিকম্প নিয়ে কোন সদস্যের প্রশিক্ষন আছে?(হ্যাঁ/ না)
১*						
২						
৩						
৪						
৫						
৬						
৭						
৮						

* উত্তরদাতা নিজে ১ম সদস্য হিসেবে বিবেচিত হবেন

বয়স	লিংগ	শিক্ষাগত যোগ্যতা	পেশা		প্রতিবন্ধকতার ধরন
১০ বছরের কম = ১ ১১ – ২০ বছর = ২ ২১ – ৩০ বছর = ৩ ৩১ – ৬০ বছর = ৪ ৬০ বছরের বেশী = ৫	পুরুষ = ১ মহিলা = ২ অন্যান্য = ৩	নিরক্ষর = ১ প্রাথমিক = ২ মাধ্যমিক = ৩ উচ্চ মাধ্যমিক = ৪ স্নাতক = ৫ স্নাতকোত্তর = ৬	সরকারি চাকুরি = ১ বেসরকারী চাকুরি = ২ ব্যবসা = ৩ শ্রমিক = ৪ ছাত্র = ৫ গৃহিণী = ৬	ডাক্তার = ৭ নার্স = ৮ শিক্ষক = ৯ অবসরপ্রাপ্ত = ১০ বেকার = ১১ অন্যান্য = ১২	মানসিক প্রতিবন্ধী = ১ শারীরিক প্রতিবন্ধী = ২ বাক প্রতিবন্ধী = ৩ দৃষ্টি প্রতিবন্ধী = ৪ অন্যান্য = ৫

২.৩ যদি কোন সদস্য ভূমিকম্প বিষয়ক প্রশিক্ষণ নিয়ে থাকেন তবে তার সাথে যোগাযোগ স্থাপনের জন্য মোবাইল নং _____

২.৪ উত্তরদাতার ভবনে মালিকানার তথ্য

- বাড়িওয়ালা
- ভাড়াটিয়া
- অন্যান্য

২.৫ এই পৌরসভা/ সিটি কর্পোরেশনে কত বছর যাবত আছেন ? _____

২.৬ পরিবারের মোট মাসিক আয় (টাকায়)

- ২০,০০০ এর কম
- ২০,০০০ – ৩০,০০০
- ৩০,০০০- ৪০,০০০
- ৪০,০০০- ৫০,০০০
- ৫০,০০০-৭৫,০০০
- ৭৫,০০০- ১,০০,০০০
- ১,০০,০০০-১,৫০,০০০
- ১,৫০,০০০-২,০০,০০০
- ২,০০,০০০ এর বেশি

৩ উত্তরদাতার ভূমিকম্প বিষয়ক সচেতনতা, জ্ঞান এবং ধারনা

৩.১ আপনি কি ভূমিকম্প সম্পর্কে জানেন?

- হ্যাঁ
- না

৩.১.১ হ্যাঁ হলে, ভূমিকম্প বিষয়ে আপনি কি জানেন? (খোলা প্রশ্ন** এবং একাধিক উত্তর গ্রহণযোগ্য)

- এটি একটি প্রাকৃতিক দুর্যোগ
- পৃথিবীর স্থলভাগ যে প্লেট দিয়ে নির্মিত তার নড়াচড়ার কারনে এটি হয়
- ভূমিকম্পে বাড়িঘর কাপতে থাকে
- অবকাঠামোগত ক্ষতি হয়
- ভূমিকম্পে মৃত্যুঝুকি রয়েছে
- কোনটি নয়
- অন্যান্য (উল্লেখ করুন) _____

৩.২ ভূমিকম্প হলে কি করতে হয়/ করবেন? (খোলা প্রশ্ন** এবং একাধিক উত্তর গ্রহণযোগ্য)

- কাঠের কিছুর নিচে লুকাবো
- দেয়াল/শক্ত পিলারের পাশে দাড়াবো
- মাথায় বালিশ/ কম্বল ইত্যাদি রাখবো
- দ্রুত ভবন থেকে নেমে যাবো
- ছাদে চলে যাবো
- ইলেক্ট্রিসিটি/গ্যাসের লাইন বন্ধ করবো
- খুব ভয় পেয়ে যাবো
- কিছুই করবো না
- অন্যান্য (উল্লেখ করুন) _____

**খোলা প্রশ্নসমূহে উত্তরদাতাকে কোন বিকল্প (option) দেওয়া হবে না

৩.৩ আপনি কিভাবে ভূমিকম্প সম্পর্কে এসব জানতে পেরেছেন (নিম্নোক্ত বিকল্প গুলোর মধ্যে নির্বাচন করুন এবং একাধিক উত্তর গ্রহণযোগ্য)

- গণমাধ্যম (টিভি / রেডিও ইত্যাদি)
- সংবাদপত্র/ লিফলেট
- স্কুল কলেজের বইপত্র
- স্কুল-কলেজ বা কোন প্রতিষ্ঠানের ভূমিকম্প বিষয়ক ড্রিল
- পরিবারের সদস্যদের সাথে কথা বলে
- এলাকার লোকজন/ প্রতিবেশীর সাথে কথা বলে
- ভূমিকম্প বিষয়ক অনুষ্ঠান/ কর্মশালার মাধ্যমে
- নিজে থেকেই জেনেছি
- সামাজিক যোগাযোগের মাধ্যম থেকে
- অন্যান্য (উল্লেখ করুন) _____

৩.৪ ভূমিকম্পের ঝুঁকি নিরসনে সক্ষমতা এবং সচেতনতা বৃদ্ধির জন্য নিম্নোলিখিত মাধ্যমগুলির মধ্যে কোন তিনটিকে সবচেয়ে বেশি পছন্দ করেন ক্রম উল্লেখপূর্বক প্রকাশ করুন

মাধ্যমের তালিকা	**ক্রম**
গণমাধ্যম ((টিভি / রেডিও ইত্যাদি)	
সংবাদপত্র/ লিফলেট	
বিভিন্ন সাংস্কৃতিক পরিবেশনা (নাটক / গান)	
ভূমিকম্প বিষয়ক এলাকা/ পাড়া ভিত্তিক সভা/ কর্মশালা	
ভূমিকম্প বিষয়ক ড্রিল/ ট্রেনিং	
অন্যান্য (উল্লেখ করুন) _____	

৩.৫ আপনি কি আপনার এলাকার ভূমিকম্প ঝুঁকি সম্পর্কে জানেন?

- হ্যাঁ
- না

৩.৫.১ হ্যাঁ হলে, আপনার এলাকাকে ভূমিকম্পের জন্য ঝুঁকিপূর্ণ মনে করার জন্য নিম্নের যে কারণ গুলি প্রযোজ্য সেগুলিতে টিক দিন এবং প্রযোজ্য কারণ গুলোর মধ্যে সবচেয়ে গুরুত্বপূর্ণ তিনটি কারন চিহ্নিত করে তাদের ক্রম উল্লেখ করুন

সম্ভাব্য কারণ সমূহ	**প্রযোজ্য হলে টিক দিন**	**ক্রম**
ভৌগলিক অবস্থান এবং অবস্থা		
এলাকার মাটির ধরন ও প্রকৃতি (ভূতাত্ত্বিক অবস্থা)		
এলাকায় অনেক পুরানো ভবন রয়েছে		
অপরিকল্পিত স্থাপনা		
এলাকার ভবন এবং স্থাপনা সমূহ খুবই ঘনবসতি পূর্ণ		
খোলা জায়গার অভাব		
সরু রাস্তা		
এলাকায় অনেক জলাভূমি রয়েছে		
ভূমিকম্পের কারনে ভুমিধস হবার সম্ভবনা		
বৈদ্যুতিক দুর্ঘটনার কারণে আগুনের সম্ভাবনা		
অন্যান্য (উল্লেখ করুন)		

৩.৫.২ আপনার এলাকার ভূমিকম্প ঝুঁকি হ্রাস করার জন্য কি করা যেতে পারে বলে আপনি মনে করেন?

_____-

৩.৬ আপনি যে ভবনে বাস করেন সেটি কি ভূমিকম্পের জন্য ঝুঁকিপূর্ণ বলে আপনি মনে করেন?

- হ্যাঁ
- না

৩.৬.১ হ্যাঁ হলে, আপনার এরুপ ধারনার পেছনে নিম্নের যে কারণ গুলি প্রযোজ্য সেগুলিতে টিক দিন এবং প্রযোজ্য কারণ গুলোর মধ্যে সবচেয়ে গুরুত্বপূর্ণ তিনটি কারন চিহ্নিত করে তাদের ক্রম উল্লেখ করুন

সম্ভাব্য কারণ সমূহ	**প্রযোজ্য হলে টিক দিন**	**ক্রম**
নিম্নমানের নির্মাণ সামগ্রী এবং নির্মাণ কৌশল		
অনেক পুরানো ভবন		
ভবনের দৃশ্যমান ফাটল		
জরুরি নির্গমন পথের অপর্যাপ্ততা এবং অব্যবস্থাপনা		
ভবনের নিচের মাটির ধরন		
ভবনের সাথে পার্শ্ববর্তী ভবনের স্বল্প ব্যবধান		
জলাভূমি ভরাট করে বানানো ভবন		
অন্যান্য (উল্লেখ করুন) _____		

৩.৭ আপনার কি ভূমিকম্পের অভিজ্ঞতা আছে?

- হ্যাঁ
- না

৩.৭.১ হ্যাঁ হলে, শেষ কত সালে ভূমিকম্প অনুভব করে ছিলেন ? _____

৩.৭.২ আপনি তাৎক্ষণিকভাবে কি করেছিলেন? (খোলা প্রশ্ন** এবং একাধিক উত্তর গ্রহণযোগ্য)

- কাঠের কিছুর নিচে লুকিয়েছিলাম
- দেয়ালের/ শক্ত পিলারের পাশে দাঁড়িয়ে ছিলাম
- মাথায় বালিশ, কম্বল ইত্যাদি নিয়েছিলাম
- পরিবারের সাথে ভবন থেকে নেমে রাস্তায় চলে গিয়েছিলাম
- ছাদে চলে গিয়েছিলাম
- ইলেক্ট্রিসিটি/গ্যাসের লাইন বন্ধ করেছিলাম
- ভয় পেয়ে গিয়েছিলাম
- কিছুই করিনি
- অন্যান্য (উল্লেখ করুন)_____

৪। উত্তরদাতার ভূমিকম্প দুর্যোগ ব্যবস্থপনা বিষয়ক ধারনা

৪.১ আপনি কি ভূমিকম্প বিষয়ে পারিবারিকভাবে প্রস্তুতি নিয়েছেন ?

- হ্যাঁ
- না

৪.১.১ হ্যাঁ হলে, নিম্নোক্ত প্রস্তুতিগুলির মধ্যে কোনটি আপনারা গ্রহন করেছেন (একাধিক উত্তর গ্রহণযোগ্য)

- তাৎক্ষণিকভাবে ব্যবহার এবং সাথে রাখার জন্য প্রয়োজনীয় সরঞ্জাম একত্রিত করেছি
- ভূমিকম্প চলাকালীন অবস্থান করার জন্য বাড়ির ভিতরে অপেক্ষাকৃত নিরাপদ একটি জায়গা নির্ধারন করেছি
- পরিবারের সদস্যদের সাথে ভূমিকম্প হলে করণীয় বিষয় নিয়ে আলোচনা করেছি
- প্রতিবেশি এবং ভবনের অন্যান্যদের সাথে আলোচনা করেছি
- অন্যান্য (উল্লেখ করুন) _____

৪.১.১ (ক) প্রথম বিবৃতিটির উত্তর হ্যাঁ হলে, ব্যবহার এবং সাথে রাখার জন্য নিম্নোক্ত কোন কোন প্রয়োজনীয় সরঞ্জাম একত্রিত করেছেন? (একাধিক উত্তর গ্রহণযোগ্য)

- ফার্স্ট এইড বক্স
- শুকনা খাবার
- পানি
- টর্চ লাইট
- টাকা
- হুইসেল
- অন্যান্য (উল্লেখ করুন) _____

৪.১.১ (খ) দ্বিতীয় বিবৃতিটির উত্তর হ্যাঁ হলে, নিম্নের কোন স্থানটি/গুলোকে নিরাপদ হিসাবে বিবেচনা করেছেন?

- দরজার ফ্রেমের নিচে
- বীমের নিচে
- পিলারের পাশে
- দেয়ালের পাশে
- টেবিল/খাটের নিচে
- ছাদে
- সিঁড়িতে
- অন্যান্য (উল্লেখ করুন) _____

৪.২ আপনি কি ভূমিকম্পের পর প্রয়োজন সাপেক্ষে আশ্রয়কেন্দ্রে যাবেন?

- হ্যাঁ
- না

৪.২.১ যদি হ্যাঁ হয় তবে আশ্রয়কেন্দ্র হিসেবে নিচের যে জায়গাগুলো আপনি পছন্দ করেন সেগুলোর পাশে টিক দিন। কোনটি পছন্দ না হলে টিক এর পরিবর্তে পছন্দ না করার কারনটি লিখুন। পরবর্তীতে নিম্নোলিখিত জায়গাগুলির মধ্যে কোন তিনটিকে সবচেয়ে বেশি পছন্দ করেন ক্রম উল্লেখপূর্বক প্রকাশ করুন

জায়গার নাম	**পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন**	**শুধুমাত্র পছন্দের জায়গা গুলোর ক্রম**
খোলা জায়গা		
খেলার মাঠ		
শিক্ষা প্রতিষ্ঠান		
ধর্মীয় প্রতিষ্ঠান		
সরকারি প্রতিষ্ঠান		
অন্যান্য (উল্লেখ করুন) _____		

৪.২.২ যদি না হয়, তবে কেন যেতে চান না ? _____

৪.৩ ভূমিকম্পের পর আপনি/ আপনার পরিবারের কোন সদস্য কি স্বেচ্ছাসেবক হিসেবে কাজ করতে ইচ্ছুক?

- হ্যাঁ
- না

৪.৩.১ যদি হ্যাঁ হয় তবে স্বেচ্ছাসেবক হিসাবে আপনি/ আপনারা নিম্নলিখিত কাজগুলোর মধ্যে কোনগুলো করতে চাইবেন সেগুলোতে টিক দিন, যেগুলো করতে চাইবেন না সেগুলোতে টিকের পরিবর্তে কারণটি লিখুন। পরবর্তীতে টিক দেয়া কাজ গুলোর মধ্যে কোন তিনটি বেশি পপছন্দ করবেন ক্রম উল্লেখপুর্বক প্রকাশ করুন। (এক্ষেত্রে ছক ২.২ এর সদস্যক্রম অনুসরণ করতে হবে)

স্বেচ্ছাসেবী কাজের তালিকা	১ম সদস্য		২য় সদস্য		৩য় সদস্য		৪র্থ সদস্য	
	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম
নিবন্ধন ও তথ্য সংক্রান্ত								
উদ্ধার কার্য								
ত্রাণ ব্যবস্থাপনা								
প্রাথমিক চিকিৎসা/ মানসিক পরিচর্যা								
আশ্রয়কেন্দ্র/ চিকিৎসাকেন্দ্র ব্যবস্থাপনা								
খাদ্য প্রস্তুতি ও ব্যবস্থাপনা								
অন্যান্য								

স্বেচ্ছাসেবী কাজের তালিকা	৫ম সদস্য		৬ ষ্ঠ সদস্য		৭ম সদস্য		৮ম সদস্য	
	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম	পছন্দ হলে টিক দিন / পছন্দ না করার কারণটি সংক্ষেপে লিখুন	পছন্দের কাজ গুলোর ক্রম
নিবন্ধন ও তথ্য সংক্রান্ত								
উদ্ধার কার্য								
ত্রাণ ব্যবস্থাপনা								
প্রাথমিক চিকিৎসা/ মানসিক পরিচর্যা								
আশ্রয়কেন্দ্র/ চিকিৎসাকেন্দ্র ব্যবস্থাপনা								
খাদ্য প্রস্তুতি ও ব্যবস্থাপনা								
অন্যান্য								

৪.৪ আপনি কি আপনার ওয়ার্ডের ডিজাস্টার ম্যানেজমেন্ট কমিটির কাজের সাথে সম্পৃক্ত হতে চান?

- হ্যাঁ
- না

৪.৫ আপনি কি বর্তমানে আপনার ওয়ার্ডের আর কোন কমিটি/ সামাজিক কার্যক্রমের সাথে জড়িত আছেন ?

- হ্যাঁ
- না

৪.৫.১ যদি হ্যাঁ হয়, তাহলে সেটি কি উল্লেখ করুন _____

৫। ভূমিকম্পে ঝুকি নিরসনে বাড়িওয়ালার সম্মতি (বাড়িওয়ালার জন্য)

৫.১ যদি আপনার ভবন ঝুকিপূর্ণ হিসেবে চিহ্নিত হয় তবে আপনি ভবন ঝুকিমুক্ত করনে/ শক্ত করতে রাজি আছেন? (ধারনা করুন, ভবন শক্ত করনের জন্য ঝুকির উপর নির্ভর করে বর্তমান নির্মান খরচের ৫% থেকে ৩৫% পর্যন্ত খরচ হতে পারে)

- হ্যাঁ
- না

৫.১.১ যদি হ্যাঁ হয় তবে আপনার কোন ধরনের সহায়তার প্রয়োজন আছে ?

- আর্থিক সহায়তা
- কারিগরী সহায়তা
- অন্যান্য

৫.২ যদি প্রয়োজন হয় তবে রাস্তা প্রশস্ত করনের জন্য আপনি কি আপনার ভুমির অংশ দেবেন ?

- হ্যাঁ
- না

APPENDIX B

Clusters of Ward 19, Tangail Pourashava

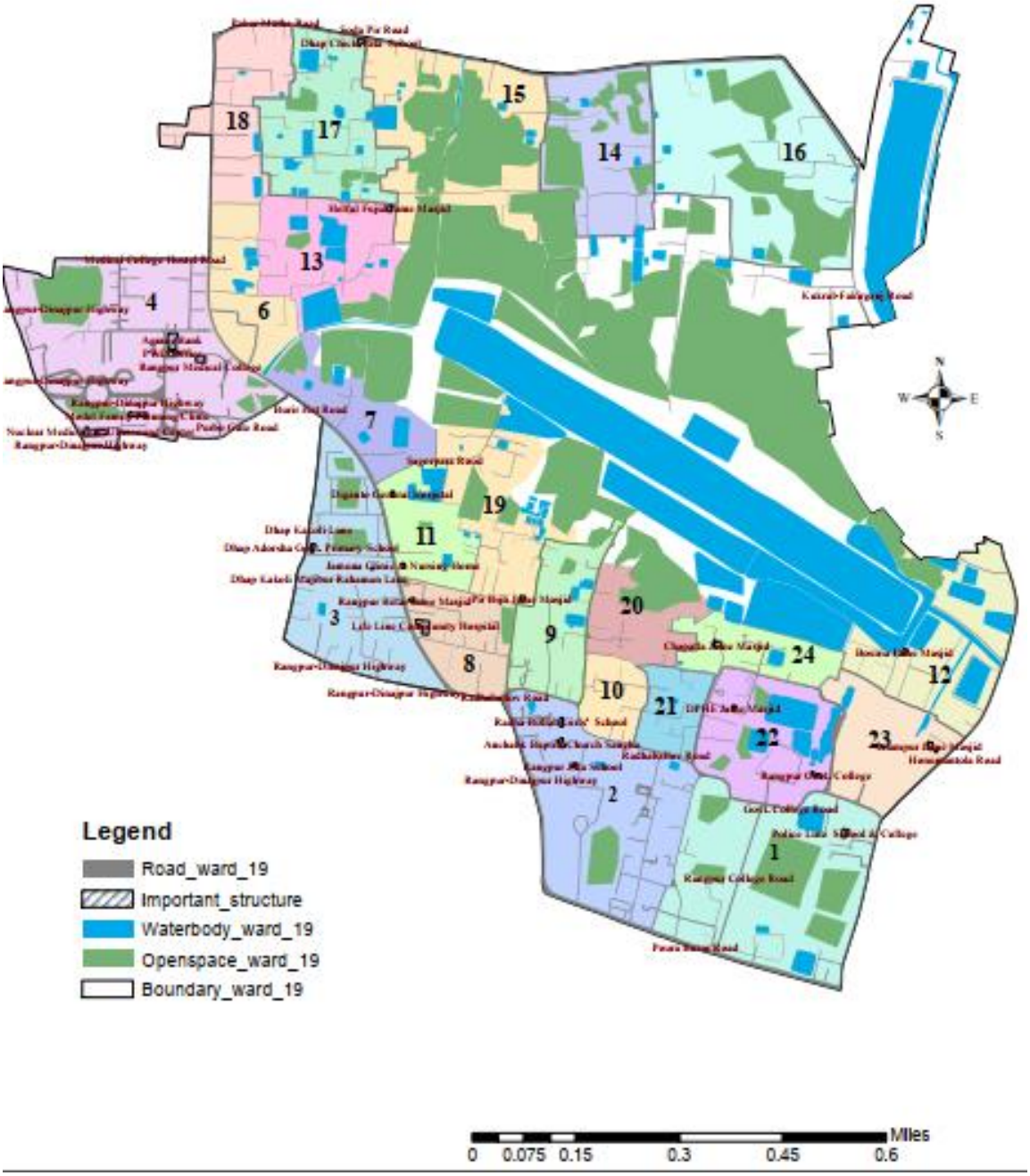

Figure: Map showing clusters of Ward 19, Tangail Pourashava

APPENDIX C

Checklist for Data Updating

Checklist for Data Updating

1. Ward No

2. Building ID

3. Holding No

4. Type of the structure

    1. Pucca 2. Semi-pucca 3. Kutcha

5. Number of storey

6. Building use

    1. Residential 2. Commercial 3. Industrial 4. Educational

    5. Community facilities 6. Health 7. Administrative 6. Religious

    7. Others

    If "Educational", please specify the type _____

    If "Health", please specify the type _____

    If "Religious", please specify the type _____

    If "administrative", please specify the type _____

    If "community facilities", please specify the type _____

7. Width of adjacent road (in feet)