ダッカにおける住民の地震リスク認識と安全対策傾向に関する調査報告

Survey Report on Seismic Risk Recognition and Intention for Safety Measures of Residents in Dhaka, Bangladesh

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Dhaka is vulnerable to earthquake because many buildings have been constructed in an unregulated manner for a long time without following the proper construction design and methods based on Bangladesh National Building Code. In order to check the building construction condition and residents' seismic risk recognition including their intention for safety measures, the authors conducted a questionnaire survey among 720 residents in Dhaka in 2010. Based on a previous paper, this paper reports some findings including (1) majority of the residents suspect that major earthquake may struck Dhaka in near future, and (2) their residential buildings may perform poorly in that earthquake.

1. Introduction

Dhaka is a megacity in Asia with a high population growth and density. The city is prone to natural disasters including earthquake, which poses threat to the urbanization. Seismic experts suspect that if a major earthquake happens in Dhaka, there would be huge destruction due to structural failure of many buildings built without proper construction materials or in violation of building code [1]. In most of the densely populated areas of Dhaka, different type of buildings are being constructed without any open spaces and most have encroached upon the next buildings, streets or roadways. As a result, collapse of these structures will block streets, further hindering rescue operations [2] in earthquakes.

Bangladesh located in a seismically active zone, close to the junction of two subduction zones created by two active tectonic plates, the Indian plate and the Eurasian plate. The Great Indian Earthquake of magnitude 8.7 generated here and affected Dhaka in 1897 and caused extensive destruction to masonry structures [3]. Recently Bilham and England (2001) [4] reported that it would recur and affect Dhaka at anytime. The earthquake risk index (EDRI) for Dhaka stands top among the 20 high risk cities in the world [5], mainly due to its inherent vulnerability of building infrastructure, dense population, poor emergency response and recovery capacity [3]. Bangladesh National Building Code (BNBC) 1993 enacted to establish minimum standards for design, construction, quality of materials, and maintenance of the buildings. However, the rapid urbanization, increasing number of building and their construction practice, questions the risk recognition of the inhabitants of Dhaka. If the construction practice is not checked and monitored at this stage, the threat of huge destruction may not be possible to prevent in case of major earthquake. The building quality of Dhaka needs to be improved to withstand with the possible seismic intensity. In order to do so, it is necessary to know the reason behind the practice: How do people recognize risk of their residential building? Do they recognize the occurrence of a large earthquake in Dhaka in near future? The answer of these questions was searched and analyzed in a previous paper [6]. This paper reports some outcome of that paper with emphasizing a Japanese research of Kato et al. [7], who examined resident's risk recognition and intention for safety measures in Tokyo's two districts (Sumida and Setagaya) based on local characteristics. It attempted to analyze in an efficient way. But there was no such research on Dhaka. Based on the importance of such research, this study tends to be an effort on that exploring (i) the seismic risk recognition of the residents, and (ii) their intention for residential safety measures.

2. Field Survey

To understand resident's seismic risk recognition and intention for safety measures, both quantitative and qualitative methods were applied in this study and primary data was collected by face-to-face questionnaire survey.

2.1 Objective Area

Dhaka City Corporation (DCC) has ninety administrative wards. Eighteen wards were selected to conduct the survey. For the population size of wards, the sample size was decided forty from each ward. The ward characteristics data of ninety

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wards were collected from the DCC, Bangladesh Bureau of Statistics, and Bangladesh University of Engineering and Technology (BUET). The scattered data were organized in ten variables including area, number of household, population, density, household size, number of building, building density, number of block, open space and estimated forthcoming earthquake intensity [8]. Fig. 1 shows the selected wards for survey.
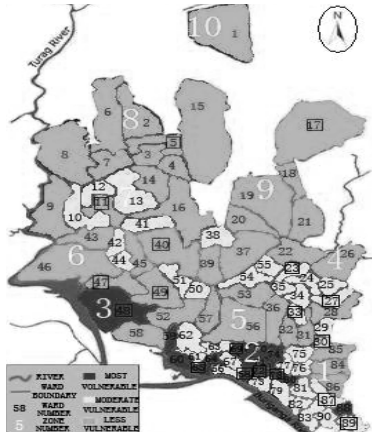

Figure 1: Ward map of Dhaka with selected wards for survey

2.2 Contents of Questionnaire

The questionnaire had the following content shown in Table1.

Table 1: Content of the Questionnaire

Part-I Basic Information of the Respondents	a) address, b) sex, c) age, d) academic qualification, e) occupation, f) monthly income, g) family member number, h) construction age of house, i) ownership, j) floor space, k) type of house, l) major structure, m) current value, n) rent of house
Part-II Knowledge on Risk Recognition	a) disaster experience, b) types of disasters, c) lost anyone in disaster, d) most severely affecting disaster to life, e) suspicion of major earthquake, f) anticipated time, g) hazard information source, h) damage suspicion in ward, i) in mahalla[1], j) own house, k) acceptable damage, l) causes of destroyed house in earthquake, m) concern about neighborhood
Part-III Intention for Safety Measures	a) measures for residential safety, b) safety action for earthquake suspicion, c) reliable actor for safe construction, d) willingness to pay, e) capacity, f) required support for household strengthening, g) willingness to pay extra rent, h) facilities to be protected with high priority, i) any organization working for risk reduction, j) knowledge on BNBC

2.3 Conduction of the Survey

The survey of face-to face interview with questionnaire sheets was conducted from June 15 to July 7, 2010. Three native university students supported the first author to conduct the survey in separate wards simultaneously. Total 720 samples were collected.

2.4 Interview of Experts

Based on the primary data findings after the survey, it was

necessary to conduct some interviews with experts on the necessity of knowing BNBC by residents. Total four experts were interviewed on the issue.

3. Outline of the Survey

The survey interview conducted with 341 female and 379 male respondents. Their age was categorized into five categories. It is shown in Fig. 2. Most of the respondents were aged between 30-39 years. The educational qualification is shown in Fig. 3. The highest 23.9% respondents were SSC (Secondary School Certificate) passed. Fig. 4 shows the occupation of the respondents, where the highest 39.3% were housewife. Fig. 5 shows the monthly income of the respondents. The average income of the resident in Dhaka is BDT 20000 which is equivalent to USD 280.
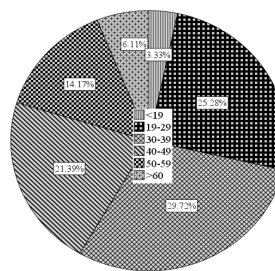

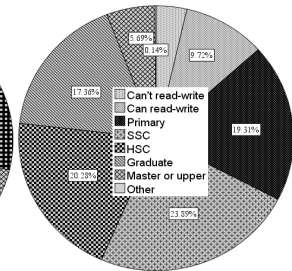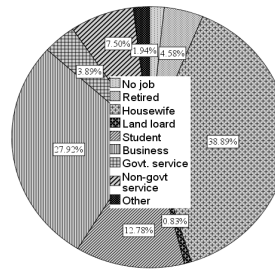Figure2: Age of Respondent   Figure 3: Qualification
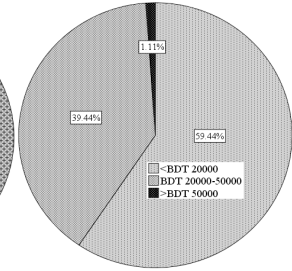

Figure 4: Occupation   Figure 5: Monthly Income

Fig. 6 shows the surveyed buildings into four categories. The first category was from 1800 to 1971. The second category was from 1972 to 1993, before the enactment of BNBC in 1993. The third category was until date. The fourth category shows the percentage of respondents who do not know about the age or construction year of their residences. Fig. 7 shows the ownership of houses. Only 35.7% people live in their own houses. Nearly 13.9% people live in family or relative house. The survey covered 49.5% house owners and 49.5% tenants
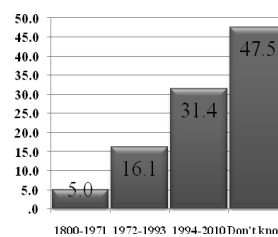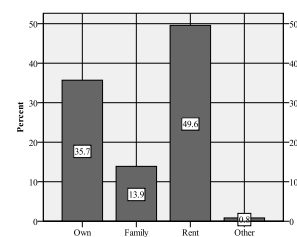

Figure 6: Construction Trend   Figure 7: Ownership of House

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[1] A small neighborhood, where, mostly people know each other. It is smaller than a ward, but not an administrative unit.

4. Risk Recognition of Residents of Dhaka

To understand resident's risk recognition for next strong earthquake, four questions were asked: (1) event that would severely affect their life, (2) if big earthquake may struck Dhaka, (3) anticipated time, and (4) their action for earthquake suspicion. Fig. 8 shows 61.5% people think that earthquake would severely affect their life. Fig. 9 and Fig. 10 show 91.9% people think strong earthquake may strike Dhaka and 45.8% suspect it in 5 years. Fig. 11 shows their action intention for Fig. 9, where 57.5% expressed desire for earthquake resistant house.
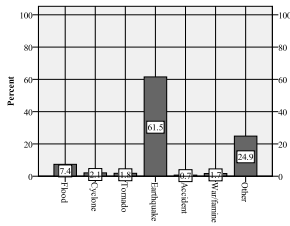

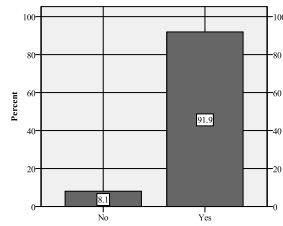Figure 8: Most affecting event   Figure 9: EQ in Dhaka
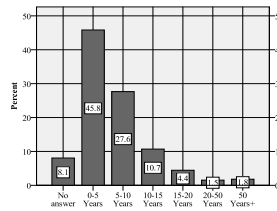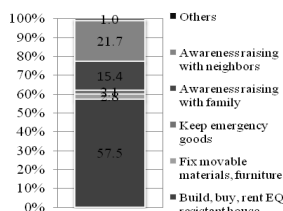

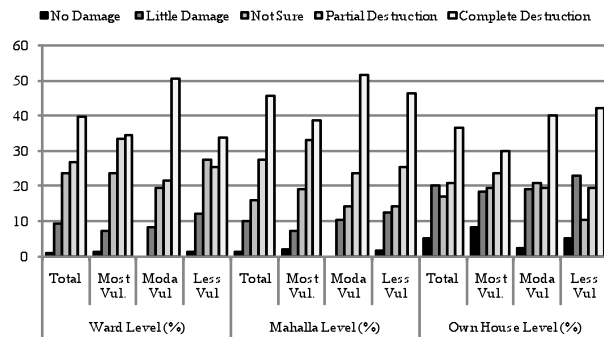Figure 10: Time anticipation   Figure 11: Action right now

Figure 12: Risk Recognition for House Damage

Then residents' risk recognition for household damage was checked. Three questions were asked on household damage suspicion in Ward, Mahalla, and in own house. 1-5 Likert Scale evaluated the response, where 1 stands for lowest agree and 5 for highest agree. Fig. 12 shows the result. In case of most vulnerable ward, the result trend is linear and most of the respondents suspect complete destruction of buildings. Three columns of total value suggest that the suspicion for complete destruction is highest in Mahalla level. It is probably because residents know each-other and neighboring buildings better than the Ward area. This made their conscious level higher for Mahalla level. It was found that residents suspect minimum damage in case of own buildings. The value for own building

damage in all level found lesser than other two levels. This tendency is called normalcy biased, where residents made an assumption as such severe event never have occurred, that will never occur.

A question may come how residents suspect the damage in residential buildings. It is because they know the major structure of their building (Fig. 13), and they did not know the BNBC while building construction (Fig. 14). Thus, they suspect poor performance of buildings. This was verified with the possible cause of building collapse in earthquake. Residents identified four causes as stated in Table 2. The central tendency of data (mean value) shows some unknown reason in highest position. Cost cut and building construction without proper design came in the second position.
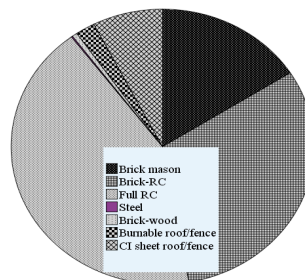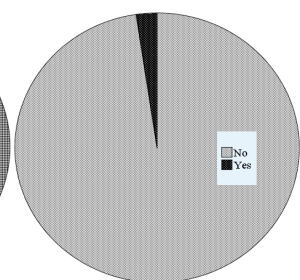

Figure13: Construction Type   Figure14: Knowledge on BNBC

Table 2: Central Tendency of Collapsed Building (Mean Value)

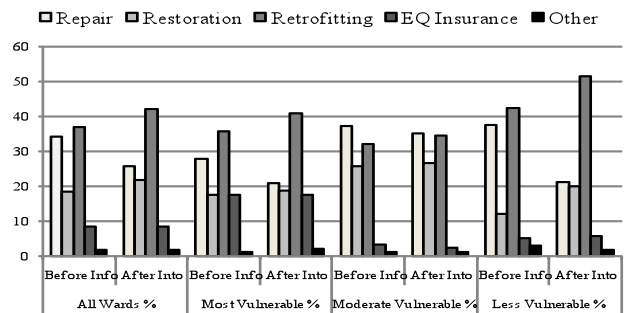| Cost Cut	Lack of Info	Without Design	Other
50.92	40.41	50.93	68.25

5. Intention for Safety Measures

Figure 15: Intention for Safety Measures

Finally, the study checked resident's intention for safety measures. One question was asked: what are the measures that you know and you can take to decrease the risk of your house in earthquakes? The question was asked two times: first time without giving any hazard information, and second time with giving some specific information on earthquake in Dhaka, structural performance of buildings, and cost related information. The questionnaires content this pictorial information. At this stage of interview, it was handed over to the respondent. They read it, and in some cases, the surveyor explained it. Then the question was repeated. The possible four methods of repair, restoration, retrofitting and earthquake insurance were also

introduced to the respondents, before they answer. Fig. 15 shows the result. In all cases, retrofitting was desired by maximum respondents and it raised after giving information. The highest consciousness level is seen in less vulnerable wards. In the second position, respondents chosen restoration, though the process is expensive as it requires complete restoration or renovation of the building. There is a trend in Dhaka, which was revealed during the survey that people want to destroy their current detached houses and construct apartment buildings with the assistance of building Developer Company.

6. Interview

The study found that there was a gap between resident's knowledge on BNBC and safety construction. They could not follow the provision of BNBC as they were not aware. This required to check the necessity of resident's knowledge on BNBC. To understand this, interviews were conducted with four experts. The first interviewee told that residents do not need to know the BNBC as it is for the professionals, who will take care of the construction, and RAJUK should monitor. The second interviewee expressed the same opinion except he thinks that residents may know the basic information of the BNBC. He added that HBRI can produce some easy version of BNBC for the residents. The third interviewee thinks that there is no need for the residents to know the BNBC. The last interviewee expressed the need for BNBC's basic knowledge for the residents, so that they can monitor the proper construction of their buildings, as per the code. The interview result suggests that residents need not to know much about the BNBC, but they should know the basic information. Then they can monitor their building construction. However, the study revealed that resident's knowledge on building code is essential to reduce structural vulnerability of residential buildings. It recommends seismic and BNBC related awareness and preparedness among the residents.

7. Conclusion

Dhaka's rapid urbanization does not follow building construction code properly. If a large earthquake strikes, it may cause severe devastation. This study conducted an investigation and provided useful information on seismic risk recognition and intention for safety measures of the residents. Primary data was collected from questionnaire survey and the result shows that majority of the respondents recognize occurrence of major earthquake in Dhaka in near future. They also recognize that their building might be severely affected. They were not aware about the seismic vulnerability of Dhaka and the necessity of using proper plan and materials for building construction. The study found a gap between knowledge and

implementation of BNBC. Very few residents knew about it but could not monitor if it was followed in their building or not. The study conducted some interviews with experts on the necessity of knowing building code by the residents. Experts expressed that citizen need not to know about the building code as it is for the professionals. They can only know some basic information, so that they can monitor its implementation. The study suggests that seismic awareness and preparedness are needed for residents. Resident's knowledge on BNBC is essential in order to reduce the structural vulnerability of residential buildings.

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