Fire Risk and Safety Assessment of Residential Buildings in Dinajpur Sadar Upazilla

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Abstract

Fire, with its unexpected appearance and destructive character, is one of the common challenges faced by urban areas as the development of multistoried structure have expanded. Even though Dinajpur is the biggest locale among every one of the sixteen northern areas of Bangladesh, it is noticed that the assessment of fire risk in Dinajpur Sadar Upazilla is yet to be made. The risk indexing method is adopted as the principal method in this study. Data is collected by extensive survey in Dinajpur Sadar Upazilla and weightage is given to the parameters for risk indexing. A total of 176 buildings comprising 95 five-storied, 57 six-storied, 17 seven-storied, 2 eight-storied, 3 nine-storied, and 2 ten-storied buildings are surveyed. By analyzing the fire risk, nearly 40% of the buildings are assessed to be in high-risk scoring and 60% of buildings are in moderate risk scoring. The findings of the research may help the respective authority to take necessary steps to improve the fire-fighting facility and to ensure better fire safety.

Keywords: *Fire risk index; Residential building; Risk; Safety*.

1. Introduction

Fire is perhaps the soonest development of human progress and has consistently been a fundamental piece of our reality on the earth. But fire episodes are alarmingly expanding all over Bangladesh especially metropolitan zones. Even though fire perils can't be completely wiped out, a relating hazard can be limited by better readiness and arranged moderation techniques created based on far-reaching examination. Based on this concept many studies have been conducted in the past. Recent work in the area of fire risk assessment and its application was reported in (Hadjisophocleous et al., 2004). Among the different available assessment methods, risk indexing is the most widely used quick method for fire risk indexing suggested by the (Hadjisophocleous et al., 2004; Jurgita Šakėnaitė 2010; Watts et al., 2016).

The number of fires has increased more than threefold across Bangladesh since 1997; with the year 2018 seeing a daily average of 53. Fire mishap rose by 22.5% from a year ago. In the year 2020 complete 21073 fire mishaps happened losing the property of 2466595044 tk. (BFSCD).

Especially from the year 2016 to 2020 complete 647 mishaps happened in Dinajpur and absolute misfortune is 31445000 tk (BFSCD, Dinajpur). From the analysis of the distribution pattern of fire incidents, it was found that the frequency of incidents is highest in residential land use category 36% (Tishi et al., 2019) In the previous study it was found that approximately 60.44% and 37.53%structures were moderately and lightly vulnerable respectively in north Dhaka by (Rahman et al., 2017). 32% area is at high risk and 45% is at moderate risk of fire hazard in Nimtali Dhaka was reported in (Sahebi et al., 2020). So alongside the outline of different methods of assessment, the evaluation of risk and building distribution of Dinajpur Sadar Upazilla is the aim of this study. The study of existing fire protection facilities in the multistoried building of Dinajpur Sadar Upazilla is also an objective and a comparison with BNBC code heightens the study.

2. Study area

Dinajpur municipal area was selected as the study area. Dinajpur is located in the north-western part of the country and is situated in the Rangpur division, Bangladesh. Dinajpur Sadar is located at 25.63330 N 88.65000 E. The total area of Dinajpur Sadar is 354.34 km^2. The area of Dinajpur municipal is 19.23square km. The total population of Dinajpur Sadar Upazilla is 184,159 according to Census Bureau 2012. The study was done by extensive field survey and questionnaire survey of 176 houses. As Dinajpur is a district town and average building are between five to six-story so the study considered the building from 5 stories to cover the maximum buildings of Dinajpur Sadar. A map of the study area is provided below in Figure 1.

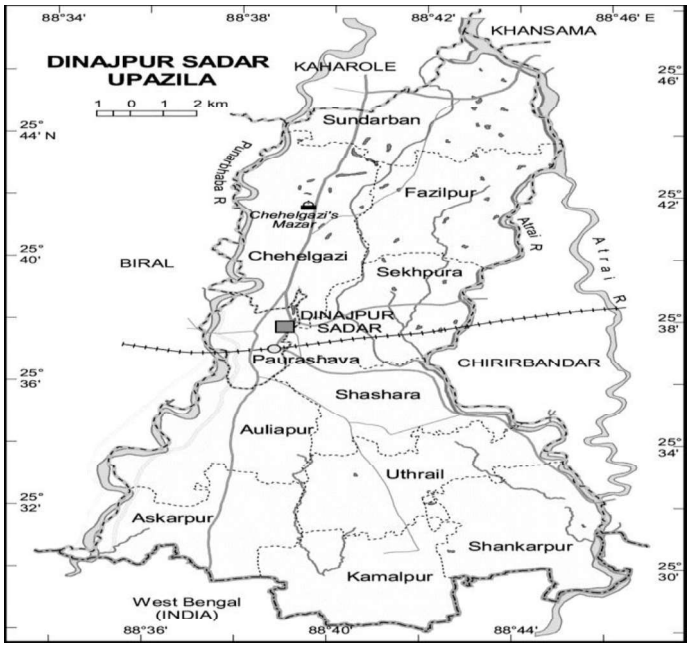

Figure 1. Map of Dinajpur Sadar upazilla

3. Methodology

Quoting Watt's third axiom of fire risk “A totally objective or scientific way to measure fire risk does not exist”. Again, it is difficult to describe a typical fire risk indexing method. The practical

necessity of trying to assess dozens or hundreds of risks with limited resources has led to the creation of an array of fire risk indexing systems. Approaches to fire risk indexing are virtually limitless in their possible variations'' (Watts et al., 2016) So, with this saying the study is encouraged to follow a simple direction which is risk indexing by expert opinion (Dodd et al., 1994; Wadud et al.,2014) The study method includes a series of related activities. Buildings from five-story are taken into consideration. In the first approach, a basic six-step for assessment is used for data collection then data are analyzed. For data analysis parameters have to be considered. A total of 16 parameters are considered. Mr. Md. Anisur Rahman, Assistant Director, Mr. Md. Mehfuz Rahman, Sub Assistant Director, and Mr. Md. Abdul Malek, inspector, Fire Service and Civil Defense, Dinajpur gave their expert opinion regarding the study. The scoring is calculated by using '0' and '1'when a parameter satisfies the provisions of BNBC or prevent fire is positive scored 1 and when the lack of any equipment or measures that protect fire is scored 0. Then the total score will be summed up and percentages will be given. The data is collected by questionary survey and home-to-home field survey. For data analysis percentages were given to each parameter and from each parameter scoring and risk categorization. The final result is obtained to determine the risk of each building. Some graphical representations of data analysis and pictures of the field surveys are attached below in Figure 2. and Figure 3. respectively as representative.

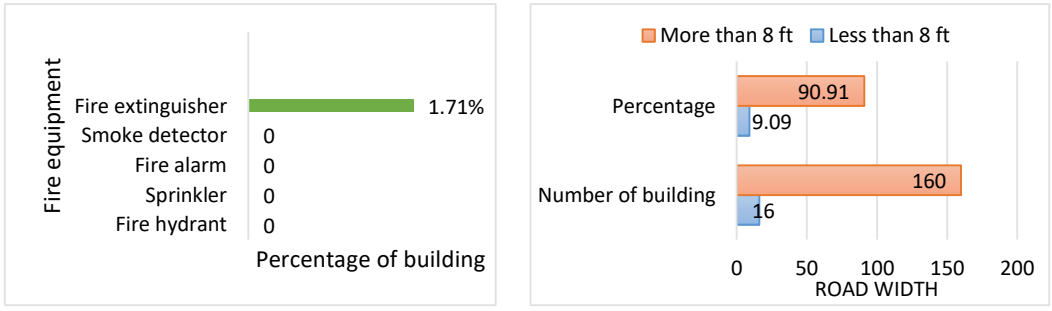

Figure 2. Analysis of fire equipment and road width of existing buildings

Figure 3. Building to building distance and fire extinguisher

When the score of a parameter is maximum it means low risk and vice versa. The approach of scoring is similar to that presented in earlier studies (Debnath et al., 2019). Table 1. Represents the risk calculation below.

Table 1. Risk calculation

Scoring	Risk categorization	Remarks
0-5.33	High	<1/3rd of total score
5.34-10.67	Moderate	1/3rd to 2/3rdof total score
10.68-16	Low	>2/3rd of total score

4. Result and discussion

4.1 Building distribution

From the study, the building distribution of Dinajpur municipality can be presented from five-story to above. Total 176 buildings were surveyed physically, during the survey it was found that 95 buildings were five-story, 57 buildings were six-story, 17 buildings were seven-story, 2 buildings were eight-story, 3 buildings were nine-story and 2 buildings were ten-story. The percentages and the number of buildings are represented graphically in Figure 4.

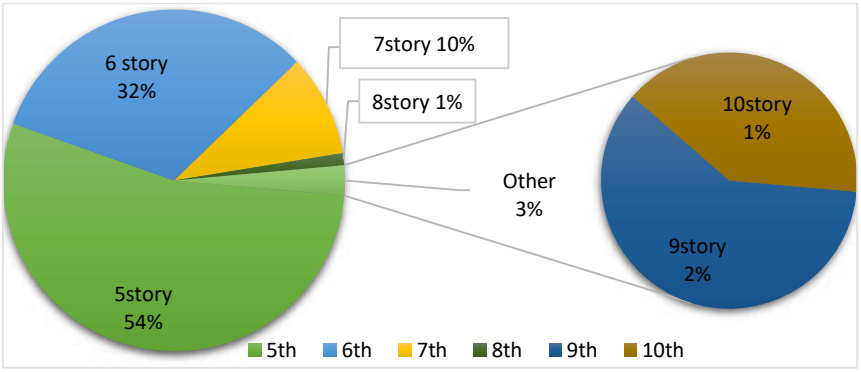

Figure 4. Building distribution

4.2 Risk categorization

In this investigation, a bigger score represents a more secure circumstance and a lower score represents a hazard circumstance. As referenced before absolute 176 structures are noticed, around 70 structures are at high risk as they score between 0 to 5.33 which is 39.77% of inclusion of 100% scale.106 structures are in the moderate risk zone scoring 5.33 to 10.67. The rate cover 60.23% of 100%. No structure was found in the generally safe zone as no structure have scored above 10.67 to 16. Risk scoring is presented in Table 2.

Table 2. Risk Scoring

Building number	Score	Risk condition
70	0-5.33	High
106	5.33-10.67	Moderate
0	10.67-16	Low

4.3 Risk categorization of the parameters

Total 16 parameters are considered for risk distribution. So, in high-risk condition 56.25% parameters are present, in moderate risk condition 12.5% and 31.25% parameters are in low

risk in the coverage of the 100 percent risk scale. Table 3. is presented below to indicate the risk parameters.

Table 3. Risk indicator parameter and value

Number	Parameter	Risk value (1- 100%)		
		High (>61%)	Moderate (60-31%)	Low (<30%)
P_1	Fire Hazard			
P_2	People at Risk			
P_3	Fire Hydrant			
P_4	Sprinkler			
P_5	Fire Alarm			
P_6	Smoke Detector			
P_7	Fire Extinguisher			
P_8	Emergency Escape			
P_9	Minimum width of Stair way			
P_{10}	Building to building distance			
P_{11}	Accessibility of fire service vehicle			
P_{12}	Distance of electric line			
P_{13}	Water tank capacity			
P_{14}	Location of fire service			
P_{15}	Training and knowledge			
P_{16}	Frequency of fire occurrence			
	Total Parameter Cover	9	2	5

4.4 Risk distribution of buildings

Risk distribution of the building is presented graphically in Figure 5.

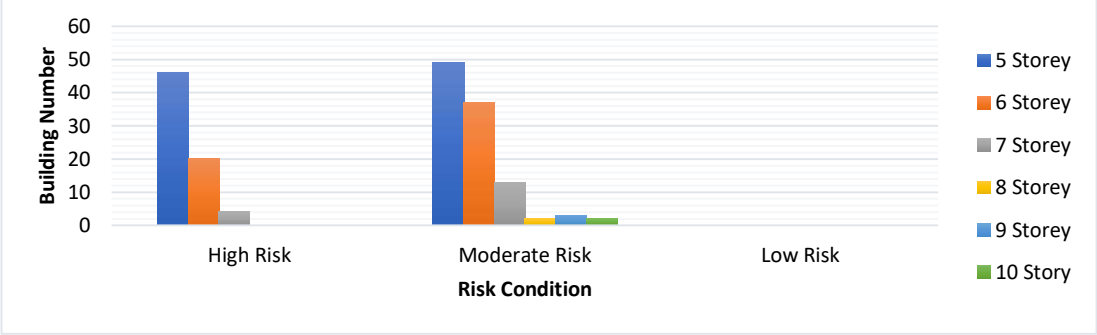

Figure 5. Risk distribution of each story building

5. Conclusion

Fire has consistently been a fundamental piece of everyday life. To guarantee wellbeing, it is needed to create mindfulness in regards to the possible perils of fire and take careful steps likewise. This paper introduced an outline of the risk categorization of Dinajpur Sadar Upazilla by the fire risk indexing method. The significant finish of the examination can be called attention to as follows,

- 60.23% of the structures are in moderate risk zone and afterward 39.77% of the structures the high-risk zone and no structure is found in the low-risk zone.
- It is discovered just 1.71% structure have fire equipment, 5% have emergency escape, 10% have adequate water reservoir capacity with regards to firefighting. Working to building distance, stair width, street width, distance from electric line are kept up by 55.68%, 68%, 90.91%, 83% structure individually.
- 9 boundaries are found in high-risk zone, 2 are found in moderate and 5 are found in generally safe zone.
- During the examination, it was streaked over and over that the building regulation isn't followed as expected and the firefighting office is least seen.it was likewise seen that new high-rise structures are ahead in keeping up BNBC code and fire offices in contrast with old ones.

Further research can be carried out on the process of ensuring appropriate firefighting facilities in every potential building with consideration of our socio-economic background. This paper worked on the residential apartment area. To get a proper overview further study should include both commercial, institutional, unorganized, and slums. The result should also be verified with another method.

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