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Causes and Remedies of Building Construction Deviation in Dhaka Metropolitan Area Regarding Stakeholders' Perception: A Case Study

Md. Eleous[1], Abdullah Al Noman *[2]

[1] Authorized Officer, Rajdhani Unnayan Kartripakkha, Dhaka, Bangladesh
[2] Assistant Authorized Officer, Rajdhani Unnayan Kartripakkha, Dhaka, Bangladesh
* Correspondence email: abdullahalnoman372@gmail.com

Abstract

Dhaka, the capital of Bangladesh, is one of the most densely populated cities in the world, experiencing rapid urbanization and significant population growth. This urban influx has resulted in an overwhelming demand for housing, leading to large-scale construction, which is often marked by widespread violations of development control rules and unplanned building construction practices. Significant problems have resulted from these haphazard constructions, such as dwindling wetlands (12.98 % in 2022), decaying green areas (from 17% in 1989 to 2% in 2020), insufficient road networks (7 %), and decreased open spaces (0.9 %). The city is consequently confronted with issues including waterlogging, traffic jams, and increased susceptibility to natural calamities like earthquakes and fires. Despite regulatory frameworks such as the Detailed Area Plan (DAP) 2022–2035 established by Rajdhani Unnayan Kartripakkha (RAJUK); which is the capital development authority, deviations in building construction are prevalent, with commercial, industrial, and residential buildings encroaching on conservation zones and failing to adhere to zoning and setback provisions. This study aims to explore the underlying causes of construction deviations, assess the current state of such violations through field surveys, and identify potential solutions based on stakeholder perspectives. The findings of this study can guide coordinated efforts among government agencies, non-governmental organizations, civil society, and construction stakeholders to improve compliance with building regulations, promote sustainable urban development, and enhance the quality of life in Dhaka

Keywords: causes and remedies; building deviations; planned city; development control; setback; responsibility and liability; disaster risk reduct

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1. Introduction

Bangladesh is a densely populated developing nation. Furthermore, Dhaka, the nation's metropolis, is the sixth most densely inhabited city globally [1]. Rapid urbanization and improved economic facilities have drawn numerous people from all around the nation to Dhaka. The total size of the Dhaka metropolitan region is 1530 km² [2]. Due to the massive influx of people into the Dhaka metropolitan area, there is an enormous demand for housing [3]. Developers and landowners are constructing reasonably priced, multi-story structures. However, numerous Dhaka buildings exhibit instances of development control rule violations [4]. Other public amenities in Dhaka are not being built in proportion to the growth of the housing industry [5]. As a result of the overpopulation, other government utility suppliers are also having trouble delivering adequate services. One of the main obstacles to developing a contemporary, livable metropolis in the twenty-first century is Dhaka's haphazard building construction [6]. Greenery, water bodies, road networks, and open spaces in Dhaka are all significantly impacted by haphazard and unplanned building construction [7]. The amount of open space in Dhaka is a negligible 0.9% of the city's overall area [8] . In order to sustain traffic management, a city must have roads on at least 25% of its land, yet Dhaka only has 7% of its land covered by roadways [9]. Over time, the proportion of wetlands in the Dhaka metropolitan region has been steadily declining; as of 2022, wetlands accounted for just 12.98 percent of the entire area [10]. Frequent waterlogging in this metropolis is also caused by the overabundance of concrete, the filling up of lakes, canals, and waterbodies, as well as a subpar drainage system. The United Nations Environment Program (UNEP) standard states that in order to guarantee livability, a city should have at least 25% of its total area dedicated to green space [11], [12]. The percentage of healthy green space dropped from 17% in 1989 to just 2% in 2020 [13]. Furthermore, in the event of an earthquake or a fire, haphazardly constructed buildings might have disastrous results. Every developer or individual wishing to build a structure must get approval from the Dhaka metropolitan city development authority, Rajdhani Unnayan Kartripakkha (RAJUK). RAJUK has the authority to plan, develop, and oversee Dhaka's growth. The RAJUK-created Detailed Area Plan (DAP) 2022-2035 is a thorough blueprint and master plan for the city's planning, especially for a city as dense and complex as Dhaka. It has been revealed by the new DAP that the RAJUK jurisdiction is not set up just to develop a central area. The jurisdiction encompasses the other city corporations and municipalities as well as villages, floodplains, rural areas, and unevenly developed areas. Even with acts and regulations, deviations in building construction are frequently observed in Dhaka metropolitan. About 67% of commercial and 51% of industrial buildings within the Dhaka

Metropolitan Area do not comply with the land use zoning by the Detailed Area Plan (DAP) [7]. It also reveals that approximately 10% of commercial buildings, 9% of industrial buildings, and 6% of residential buildings have encroached upon conservation zones (such as open space, flood-prone zones, water bodies, playgrounds, parks, and proposed areas for future road extension, etc.), which is forcing people to live in relatively small and cramped spaces [7]. Living in confined and crowded spaces with limited access to natural light and fresh air can heighten the likelihood of mental health and respiratory problems [14], [15], [16]. Adding to the fact that Dhaka is one of the most air-polluted cities in the world, this is a very serious problem [17], [18]. It is a major barrier to achieving healthy housing as well as Sustainable Development Goal (SDG) 11 for sustainable cities and communities in particular [7], [19], [20]. Despite previous literature looking into the impact of building control in urban areas [21], the severity of setback violations in buildings [22], existing provisions regarding setbacks [23], violation of building bye-laws [24], and major barriers to the enforcement of building codes [25], the perception of building stakeholders regarding building construction deviation has not been extensively studied. Moreover, public perception regarding the causes of building deviations as well as the remedies of this problem is not commonly seen in existing literature. Now it needs coordinated efforts of government organizations, non-governmental organizations, civil society, and, most importantly, the building construction stakeholders to provide an effective response to the mitigation of building construction deviation. This study intends to provide the reasons behind construction deviations, the current state of building deviations based on an on-field survey, and their solutions based on the opinions of stakeholders. To fill in the gaps in the application of construction laws and regulations, this study can also serve as a planning document for developing authorities.

2. Current Building Deviation Scenario of Dhaka Metropolitan

According to an analysis of the data from the Physical Feature Survey conducted as part of the RAJUK-prepared Detailed Area Plan (DAP), 2022–2035, there are 21,45,648 current facilities in the area it covers [8]. According to the detailed area plan statistics, there were 9,49,334 installations between 2008 and 2016, which is an average of almost 95,000 new installations annually [8]. Recent data analysis, however, indicates that the average yearly design approval rate is roughly 4,165 [8], [26]. Specifically, just 4.64% of the installations have been built lawfully with RAJUK's approval [8]. Furthermore, a 2018 RAJUK survey, which was carried out from January to August, discovered that nine out of ten structures in Dhaka neighborhoods were built contrary to their authorized designs [4]. During that time, RAJUK examined at least 200,000 buildings in its 1,528 square

kilometer jurisdiction that were three stories or above [4]. Of these surveyed buildings, 33% of buildings lack alternate stairs for evacuation in the event of a fire, and 70% of buildings lack fire protection precautions [27]. According to RAJUK, 34% of the remaining 67% of the building's alternate stairs are inoperable [27].

Table 1. Building in violation of RAJUK approved designs in Dhaka [4].

Areas in Dhaka	Total buildings	Designs ignored by	Percentage (%)
Ashulia, Gazipur	8874	57	0.64
Uttara, Tongi	68561	27412	39.99
Mirpur, Mohammadpur,	50119	47493	94.76
Gulhan, Banani, Baridhara,	15738	13207	83.92
Dhanmondi	17716	15903	89.77
Rampura, Motijheel, Khilgaon	21656	21088	97.38
Lalbagh, Sutrapur, Keraniganj	10700	9258	86.52
Bhulta, Narayanganj	19132	507	2.65
Total	204106	134925	66.11

More than eight out of ten structures in Gulshan, Banani, Baridhara, Niketan, Tejgaon, Lalbagh, Sutrapur, and Keraniganj were constructed with deviation from their authorized designs, according to the survey [4]. The designs are often disregarded at the cost of safety. The overall building deviation scenario of Dhaka city can be observed from Table 1.

The following are the type of most common building deviations generally found in Dhaka-

i) A building constructed without the approval of the appropriate authority;

ii) Deviation of land use as directed in the Detailed Area Plan (DAP);

iii) Exceptions to the authorized use of the building, such as commercial use of residential premises, etc.;

iv) Authorized setback of building, deviation of maximum ground coverage;

v) Exceptions to the approved floor / height of the building;

vi) Violation of the condition of leaving the required space from the land due to widening of the existing road adjacent to the applied land master plan or proposal of new road as per the approval letter;

vii) Exception of any of the conditions mentioned in the approval letter etc.

3. Consequences of Building Deviations in Dhaka Metropolitan

One Asian metropolis that is particularly vulnerable to earthquakes is Dhaka [13]. Even though there has never been a moderate to big earthquake in Dhaka's history, the city frequently experiences

mild tremors throughout the year, indicating that the area is seismically active. A nine-story manufacturing building collapsed in Savar in April 2005, killing 70 people and injuring about 200 more of its 300 workers due to poor building construction quality [28]. In Tejgaon, Dhaka, a five-story building under construction collapsed in February 2006, leaving 18 workers dead and 40 injured [28]. According to a 2018 RAJUK survey, 89 percent of the constructions in Dhanmondi, 93 percent in Rampura, Motijheel, and Khilgaon, and 94.76 percent in Mirpur, Mohammadpur, and Pallabi do not satisfy the structural and design pre-requirements [29]. In 2013, the Rana Plaza collapsed, killing at least 1,132 people and injuring over 2,500 more [28]. This is a blatant illustration of how building construction violations contribute to tragedies [28], [29].

The risk of urban fires is increasing as infrastructural development expands. The fire at Nimtoli in Chankharpool on June 3, 2010, claimed up to 124 lives and injured 50 more [30]. Firefighters found it challenging to contain the fire due to the congested neighborhood and small road [30]. The terrible fire that tore through the Chawkbazar neighborhood of Old Dhaka in February 2019 was barely a month prior to the Banani FR Tower fire tragedy, which killed 25 lives [31]. The Chawkbazar fire, which claimed 71 lives, is regarded as the nation's second-deadliest fire, following the Nimtoli disaster in 2010 [31]. In February 2024, a fire at the seven-story Green Cozy Cottage Shopping Mall on Bailey Road in Dhaka killed at least 44 people, including 26 women and three children, and gravely injured another 22 [32]. Even though the building was authorized for mixed use (residential apartments and commercial offices), restaurants were constructed there without the required occupancy permit and permission [32]. A common recipe for disasters is a combination of crowded buildings, small alleys, a lack of fire safety equipment, and insufficient fire exits in tall buildings. Building owners often disregard the "set back" regulation, making many of the roads in this city too narrow for motorized rescue vehicles [33]. Houses maintaining building setbacks ensure privacy between two consecutive buildings, ease in providing utility services, and enhance the accessibility of emergency vehicles in residential areas [34]. Almost three out of four structures in Dhaka have been constructed unlawfully and are still susceptible to earthquakes and fires [35]. It is necessary to determine the causes of these building deviations as well as the solutions. If proper construction is enforced without deviation, casualties such as these can be significantly prevented.

4. Building Deviation Control Tools and Mechanism

Tools for development control are not machinery or equipment; rather, they are components utilized to carry out the execution of development control [36]. Development control tools offer guidelines for responsible and effective development. These consist of building ordinances, zoning rules, density controls, town planning acts, and guidelines [36], [37]. To keep incompatible uses apart and protect resources, zoning regulations define what uses are allowed on property. The number of dwelling units per area is one example of how density regulations regulate the intensity of land use. Development that is safe, secure, and well-overlooked is indicated by guidelines. These different development control technologies work together to create growth that is in order. Rules and regulations formed by the government help RAJUK manage building construction deviations in a controlled manner. RAJUK and other city development bodies use the acts and rules as tools to restrict building deviations. Necessary laws and regulations related to deviation control can be observed in Table 2.

A thorough guide for urban planning and development, the Detailed Area Plan (DAP) 2022–2035 aims to support sustainable growth in the quickly growing city of Dhaka. The DAP, which was created by government officials and urban planners, addresses important facets of city planning, such as infrastructure development, land use, density zoning, environmental preservation, and public service improvement [8]. By tackling the issues of overpopulation, uncontrolled growth, and inadequate public facilities that frequently accompany fast urbanization, the plan seeks to promote balanced urban development [8], [38].

Table 2. Acts and regulations associated with building development control in Bangladesh

Types of laws and regulations	Name	Year
Planning related	Detailed Area Plan (DAP)	2022
Development related	The Building Construction Act	1952
	The Town Improvement Act (East Bengal Act)	1953
	Land Development Rules for Private Residential Projects	2004
	Bangladesh National Building Code (BNBC)	2020
Development control related	Dhaka Metropolitan Building (Construction, Development, Maintenance and Removal) Rules -2008	2008
	Natural Waterbody Protection and Preservation of Open Space and Playground Act	2000
	Historical Buildings, Structures, Important Places Preservation Act	2020

The Building Construction Act, 1952 is enacted to provide for the prevention of haphazard construction of buildings and excavation of tanks and cutting of hills which are likely to interfere with the planning of certain areas in Bangladesh [39]. The Town Improvement Act of 1953 was passed to provide for the development, enhancement, and growth of the Republic's capital, Narayanganj, Tongi, and some of the surrounding areas. This was accomplished by clearing crowded areas, rearranging or modifying streets, creating open spaces for recreation or ventilation, tearing down or building new structures, obtaining land for these purposes, and rehousing those who were displaced by the implementation of improvement projects [40]. RAJUK was formed by this act. In Bangladesh, the Land Development Rules for Private Residential developments, 2004 were created to govern the design, construction, and administration of private residential developments [41].

For the design, building, modification, and upkeep of structures in Bangladesh, the 2020 Bangladesh National Building Code (BNBC) lays out the minimal specifications. The code aims to protect the health, safety, and welfare of building occupants [42]. To control building development and construction in the Dhaka metropolitan area, the Dhaka Metropolitan Building (Construction, Development, Maintenance, and Removal) Rules, 2008 were implemented. Safety, appropriate urban planning, and adherence to environmental standards are the goals of these regulations [41]. Bangladesh passed the Natural Waterbody Protection and Preservation of Open Space and Playground Act, 2000, to protect open spaces, playgrounds, and natural water bodies from destruction and unwanted encroachment. Urban planning and environmental protection are the act's main objectives [43].

In order to preserve the country's cultural legacy, Bangladesh passed the Historical Buildings, Structures, Important Places Preservation Act, 2020, which aims to protect historical buildings, structures, and places that hold great historical or cultural significance. The purpose of the statute is to guarantee their conservation for upcoming generations [41]. There is also a method for controlling construction deviations and acting against them by employing these utilities. Dhaka's development is managed using a variety of instruments. These include land use zoning, planning standards, the application and approval of building and development permits, monitoring and enforcement, which includes stop work notices, collecting fines from building owners, removing deviated parts of buildings, eviction actions, etc. The full building deviation control technique that RAJUK uses is depicted in Figure 1.

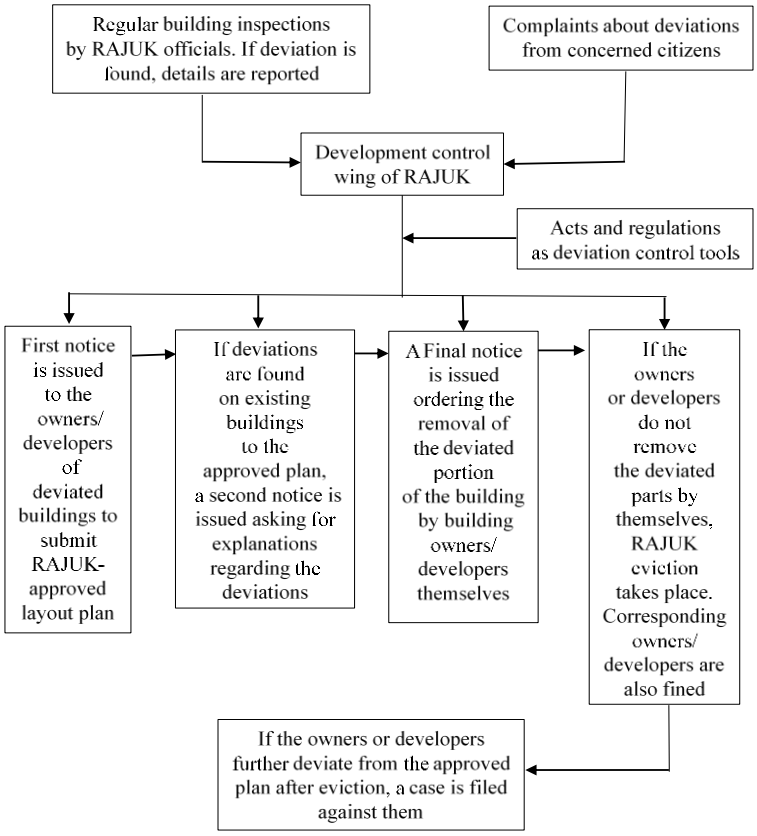

Figure 1. Existing building deviation control mechanism of RAJUK

5. Study Area

To ensure efficient management of urban growth strategies, RAJUK has divided Dhaka into eight administrative zones, each consisting of multiple subzones. Sub-zone 2 of Zone 5, which encompasses 74 land-administrative units, has been selected as the study area (Figure 2 and 3).

Figure 2. Sub-zone 5/2 of RAJUK [44]

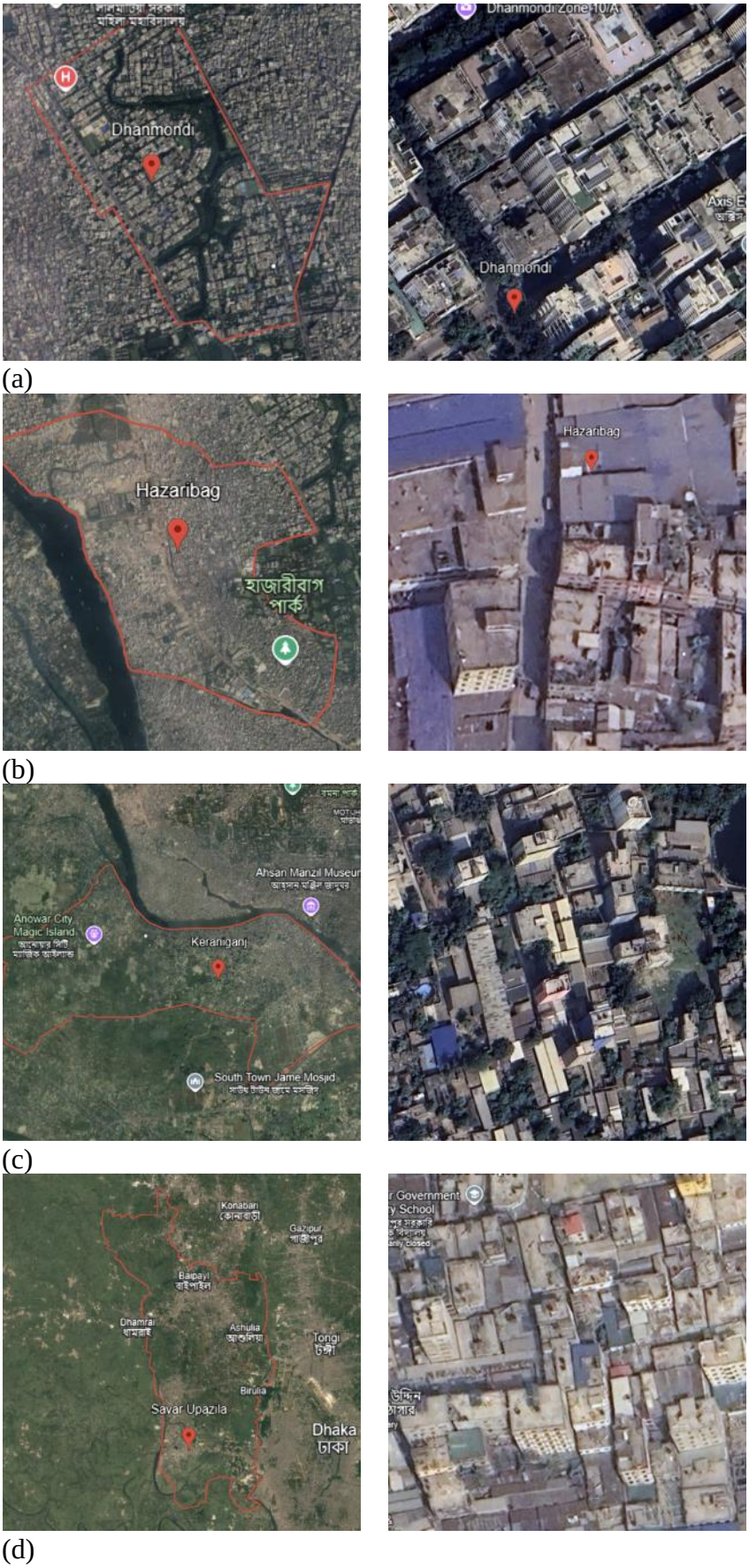

Figure 3. Google earth view of study area (a) Dhanmondi; (b) Hazaribag; (c) Keraniganj; (d) Savar

This subzone features a diverse mix of building types and tenants, offering a representative snapshot of Dhaka's urban landscape. It includes the areas of Dhanmondi, Hazaribagh, Keraniganj, and Savar, each reflecting distinct demographic and urban characteristics.

Dhanmondi, a well-known urban residential neighborhood, spans an area of 2.18 km² and has a population of 75,150, resulting in a population density of 34,461 people per km² [45]. Hazaribag is more densely populated, with a population of 200,476 within a 2.57 km² area and a population density of 77,732 people per km² [46]. Keraniganj covers a much larger area of 171.1 km² and houses a population of 1,011,063, leading to a relatively lower population density of 5,910 people per km² [47]. Finally, Savar, a rapidly growing urban area has a population of 384,105 within a 16.25 km² area, with a population density of 23,632 people per km² [48].

To understand building deviations and the factors contributing to them, on-field data collection was conducted in these areas using a structured questionnaire. Buildings were selected for the survey through a random sampling technique, ensuring an unbiased representation of diverse building types and stakeholders. The varied demographic and spatial characteristics of the study areas provide a comprehensive context for analyzing building deviation trends in Dhaka.

6. Research Method

To comprehensively investigate the causes, severity, and potential remedies for building deviations, a two-phase mixed-methods questionnaire survey approach was adopted. This methodology combined both online and on-field data collection to ensure a diverse and comprehensive dataset.

6.1. Phase 1: Online Questionnaire Survey

An online questionnaire was designed to gather insights into key issues related to building deviations. Considering the importance of demographic characteristics and the need for structured responses, the survey was divided into four sections:

(i) Types and severity of building deviations; **(ii)** Causes of building deviations; **(iii)** Remedial prospects; and **(iv)** Public perceptions on deviation prevention.

A purposive sampling technique was employed to select a sample of 50 respondents who were directly or indirectly involved in the building construction process. Respondents included architects,

engineers, developers, building owners, RAJUK officials, and conscious citizens. This approach ensured a balanced representation of stakeholders. The online format allowed for wider reach and convenience in data collection.

6.2. Phase 2: On-Field Questionnaire Survey (Dhanmondi, Hazaribag, Keraniganj, Savar)

An on-field survey was conducted to obtain detailed and context-specific information from stakeholders actively engaged in the construction process. The primary objectives of this phase were:

(i) Understanding why and how building owners and developers deviate from approved plans during construction.

(ii) Gathering detailed information on plot areas, the number of stories, and setbacks of buildings to assess deviations from approved designs.

A random sample of 31 respondents was selected, focusing on individuals such as building owners and developers directly involved in construction activities. On-field surveys provided firsthand insights into the practical challenges and motivations driving deviations.

6.3. Sample Size and Justification

The combined sample of 81 respondents (50 from the online survey and 31 from the on-field survey) was considered sufficient for the study. This sample size was justified based on its focus on participants directly involved in the construction process. The inclusion of diverse stakeholders like building owners, developers, architects, engineers, RAJUK officials, and conscious citizens ensured that the findings reflect a comprehensive understanding of the issue.

6.4. Data Validity and Reliability

To enhance the validity and reliability of the data, questionnaires were pre-tested with a small pilot group to refine questions for clarity and relevance. Responses were anonymized to encourage honest and unbiased participation.

6.5. Hierarchy Index

Social sciences and educational research involve the quantification of attributes such as ability, perceptions, qualities, and outlooks, which is why psychometric procedures are being invented, implemented, and improved [49]. The Likert scale, which bears the name of psychologist Rensis

Likert, is one of these methods. This scale, which offers a range of answers to a specific question or statement, is frequently used to measure attitude [50]. Therefore, a Likert scale was created utilizing an online questionnaire survey to gauge the attitudes and perceptions of building stakeholders on the kind of deviation that is seen to be the most severe [51]. A Likert scale with index numbers is a useful instrument for assessing people's viewpoints [52]. For this paper, scores of (+2), (+1), (0), (-1), and (-2) were substituted to highly problematic, problematic, undecided, less problematic and not problematic respectively. Firstly, each response's frequency was multiplied by its score to get the index score. Secondly, to get the weighted total, the resultant value was added. Then, as demonstrated in equation 1 below, it was divided by the total number of responses for the corresponding attribute, which is 50.

$$\text{Hierarchy index} = \frac{Weighted\ total\ score}{Total\ number\ of\ respondents} \quad (1)$$

Both descriptive statistics techniques and content analysis were used to analyze the data. Charts and tables displaying the corresponding averages and percentages were used to portray the analyzed data. Quantitative data was analyzed using Microsoft Excel. Table 3 displays the full methodology used in this study.

Table 3. Methods and sources of data collection

Types of data sources	Sources of data collection	Methods of data collection
Primary sources	building owners, developers, architects, engineers, planners, RAJUK officials and conscious citizens	Online and on-field questionnaire survey, observation from different buildings in the study area
Secondary sources	Relevant acts, rules and regulations, policies, circulars, annual reports, research reports, articles, websites etc.	Review literature and other documents

7. Results and Discussion

Based on responses from online and on-field questionnaire surveys as well as on-field building observations, the following results and discussion are presented. Of the 50 respondents who answered the online questionnaire, 44% were engineers, 38% were RAJUK officials, 10% were architects, and 8% were concerned citizens. However, out of the 31 people who answered the on-field questionnaire survey, 65% were building owners and the remaining 35% were developer companies.

7.1. Stakeholders' Perception about Different Building Deviation Hierarchy

The stakeholders' opinions regarding various kinds of building construction deviations are shown by the values of the hierarchy index. Table 4 shows how the hierarchy index for the various building construction deviation kinds was determined. This table shows ten different kinds of typical building variations. The floor area ratio is the ratio between the total amount of usable floor area that a building has or has been permitted to have and the total area of the land on which the building stands. A higher ratio would likely indicate a dense or urban construction. The occupancy category designates the intended use for a building, which affects the required design loads for the structure. According to BNBC 2020, it is mandatory to leave a certain amount of space open when constructing a building to ensure fire safety, rainwater absorption, greenery etc. A "defect in quality of materials" refers to a flaw or imperfection present within a raw material used in building construction, where the material does not meet the required specifications or quality standards, potentially impacting the functionality and performance of the structure. It is evident from examining the hierarchy indices that "setback violation" is thought to be the most serious building deviation of all the types. But according to respondents, "deviation in the number of authorized units" is the least serious building deviation. Regardless of the type of building deviation, respondents view all these deviations as "problematic," according to the values of the hierarchy index. The hierarchy index values can also be used to prioritize deviations and find out possible solutions.

Table 4. Perception of building stakeholders regarding the hierarchy of different building deviations

Types of building construction deviation	Likert scale items						
	Highly Problematic	Problematic	Undecided	Less problematic	Not Problematic	Weighted Total	Hierarchy index
	Likert scale score						
	+2	+1	0	-1	-2		
	The product of respondent frequency and Likert scale score						
Setback violation	80	10	0	0	0	90	1.8
Construction of buildings without leaving space for the proposed road	68	14	0	0	0	82	1.64
Defect in quality of materials in building construction	52	15	0	-3	-2	62	1.24
Disruption of proper safety measures during construction work	54	17	0	-2	0	69	1.38
Failure to provide proper fire safety measures	68	15	0	0	0	83	1.66
Violation of FAR (floor area ratio) included area	38	26	0	0	-2	62	1.24
Deviation in the number of authorized units	30	22	0	-2	-4	46	0.92
Disruption of Mandatory Uncovered Space/ Green Area	46	23	0	-2	0	67	1.34
Violation of building stories	60	16	0	0	0	76	1.52
Violation of the permitted occupancy	60	17	0	0	0	77	1.54

The minimum distance a building or structure must be placed from streets, property lines, or other structures is known as a setback in construction. It is a legal mandate that is upheld by regional construction or zoning codes. Setbacks are used for several purposes, such as protecting privacy, allowing for natural light and ventilation, making emergency access easier, and stopping fire from spreading to other structures. Nine out of ten respondents to the online questionnaire poll say they are fully aware of the advantages of applying the setback rule. Despite their knowledge of the setback rule's benefits, there is, in reality, apathy toward following it.

Figure 4. Existing insufficient setback area and openness in the study areas (a) Hazaribag; (b) Dhanmondi; (c) Keraniganj; (d) Savar

On-field setback measurements were taken from 31 structures, as previously noted, because stakeholders consider "setback violation" to be the most serious building deviation out of all the others. The existing insufficient setback area and openness in the study areas are illustrated in Figure. 4. The current setback limits in Bangladesh were compared with these measurements. In

order to determine whether measurements deviated from current regulations, they were also examined. Only 8 of the 31 buildings were found to have maintained appropriate setbacks when the measurements were analyzed. The plot sizes of these structures ranged from 200.74 to 1338.28 square meters. All 31 structures had 2 to 10 stories as well. No matter how many stories or how big the plot was, 74.19% of the buildings broke the government's setback restriction. Corresponding building owners and developers were questioned about the causes of their setback deviation during an on-field questionnaire survey. The following are the reasonings provided by the corresponding building owners and developers about setback violations.

i) To benefit financially. A higher setback deviation leads to a greater amount of available floor space.

ii) Not making profit according to the higher purchase price of the land.

iii) Other nearby building owners do not comply with setback rules.

iv) Due to the small amount of land, there is a possibility of financial loss if the setback is properly maintained.

v) The desired height of the building cannot be achieved by building owners/ developers due to existing floor area ratio (FAR) value.

vi) The concerned architect/engineer did not inform about the building construction laws and regulations to the corresponding owners.

7.2. Major Catalysts for Building Construction Deviation

One of the main drivers of building construction deviation, according to 46% of respondents to the online questionnaire survey, is the acquisition of utility services (gas, electricity, and water) in a building without an occupancy certificate. However, according to 38% of online respondents, the Dhaka metropolitan area's overcrowding and land scarcity are other significant factors that contribute to the diversion of building construction. There are currently 23,936,000 people living in the Dhaka metro area as of 2024, a 3.13% increase from 2023 [53]. By the end of 2025, there will be 25.4 million people living in Dhaka, according to the World Population Review [54]. Essentially, agricultural lands were transformed into built-up regions to meet the housing requirement of this enormous population [55]. Currently, 66% of Dhaka's land area is covered by built-up areas [55]. Vegetation has declined by 29% during the past 20 years, indicating that 27% of Dhaka's urban area has been transformed into built-up land [55].

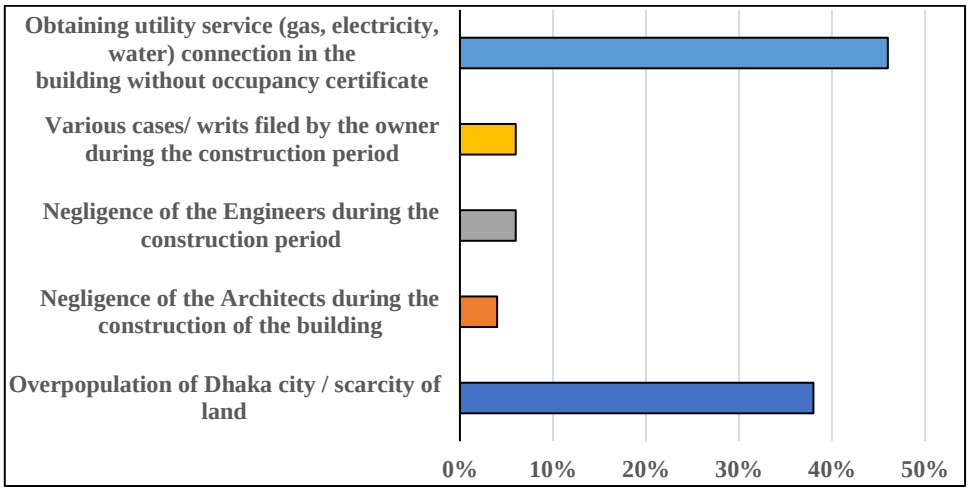

Figure 5. Major catalysts for building construction deviation according to online respondents

Dhaka's rapidly expanding population is severely affecting the city's livability, as shown by the high demand for housing, which may cause building construction to deviate from the norm. According to Figure. 5, 6% of online respondents believe that various cases and writs filed by building owners during the construction period are the primary reasons for deviations in building construction, 6% believe that engineers' negligence during the construction period is the primary reason for deviations in building construction, and the remaining 4% believe that architects' negligence during the construction period is the primary reason for deviations in building construction.

7.3. Constraints to Prevent Construction Deviations of Buildings

As shown in Figure 6, 42% of online questionnaire respondents identified RAJUK's development control wing's manpower shortage as a major obstacle to preventing building construction deviations. A significant limitation, according to 18% of respondents, is the absence of large gear for removing building deviations. Interestingly, 16% of respondents think that RAJUK personnel are not properly trained to do their jobs. RAJUK sends a letter to the local police station to immediately halt construction on a building when it discovers deviations in the currently under-construction structure. According to 14% of online respondents, a police station's failure to act appropriately can occasionally serve as a limitation.

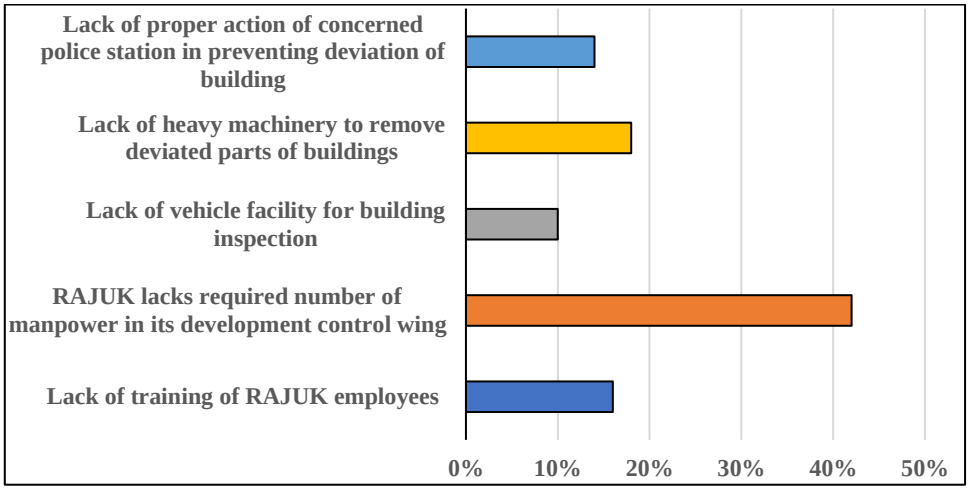

Figure 6. Constraints to prevent construction deviations of buildings according to online respondents

Another factor contributing to building construction deviation, according to the remaining 10% of online respondents, is the absence of vehicle facility during RAJUK inspectors' building inspections.

7.4. Non-Compliance of Building Stakeholders with Existing Rules and Regulations

Construction deviations can occur when building owners disregard the current building construction standards and regulations. According to Figure. 7, 36% of respondents believe that building owners' and developers' violations of building construction laws and regulations result in deviations from the approved layout. Another significant contributor to building variation, according to 28% of respondents, is building owners' unclear comprehension of building construction laws and regulations.

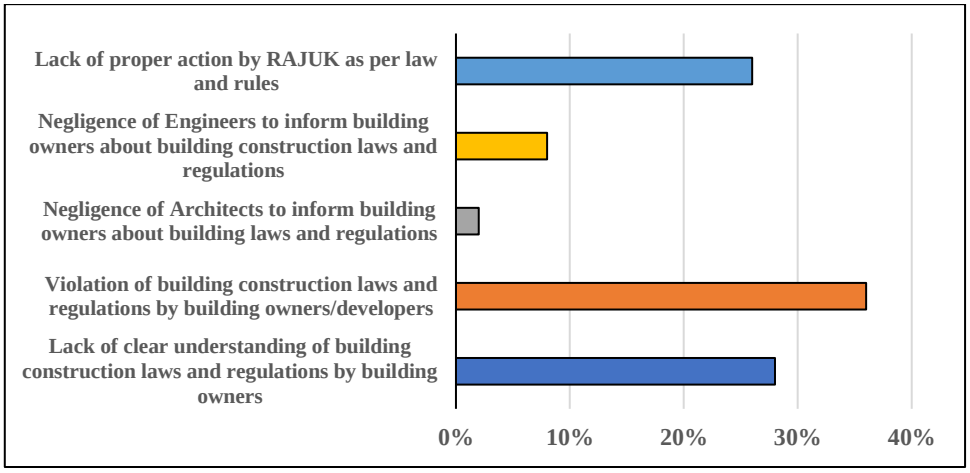

Figure 7. Non-compliance of building stakeholders with existing rules and regulations according to online respondents

Figure.7 further illustrates that 26% of online respondents think that deviations in building construction can also be attributed to RAJUK's failure to act appropriately in accordance with laws and regulations. However, 8% of respondents think that building construction deviations can be caused by engineers who fail to inform building owners of building construction laws and regulations, and 2% think that architects can cause building construction deviations by failing to inform building owners of building construction requirements.

7.5. Steps to be Prioritized in Preventing Construction Deviation

According to 54% of respondents to the entire online questionnaire poll, the accountability of the building owner in issue should be the top priority. In the event that a building is constructed contrary to the approved design of RAJUK, the structure's owner must be quickly brought under the relevant legislation. Additionally, as shown in Figure. 8, 24% of online respondents believe that RAJUK employees' accountability for building inspections must be guaranteed.

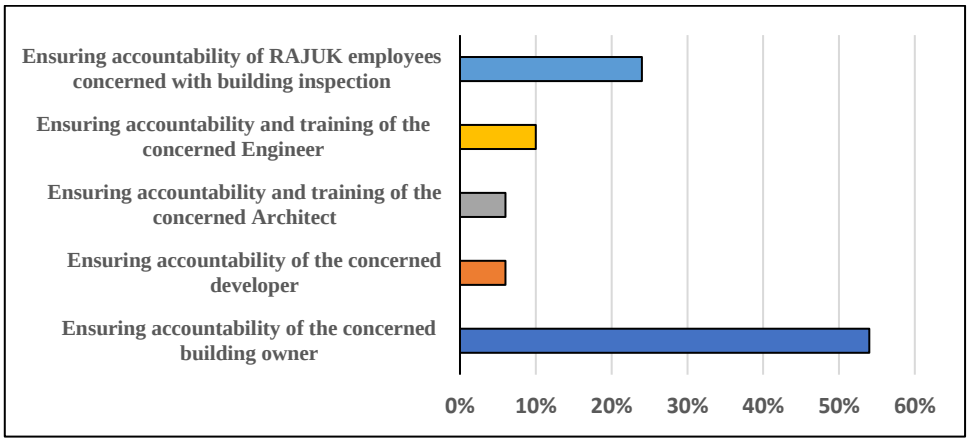

Figure 8. Steps to be prioritized in preventing construction deviation according to online respondents

6% of respondents also think that the responsible developer ought to be held responsible. To prevent deviations in building construction, 10% of respondents emphasized prioritizing the responsibility and training of site engineers, while 6% prioritized the responsibility and training of design architects.

7.6. Measures Which Can Play a Role in Preventing Building Construction Deviations

As shown in Figure 9, 47% of online questionnaire respondents believe disabling utility supplies (gas, electricity, and water) is a useful strategy to combat building construction deviations. Additionally, 21% suggest legal action, including fines, lawsuits, evictions, and mobile court-

ordered removals of deviated parts, against those responsible. 20% of online respondents think that holding frequent meetings with building construction stakeholders can help solve this issue. Additionally, according to 8% of respondents, a building can be validated after paying a certain penalty if its structural integrity and disaster tolerance are maintained even after the deviation.

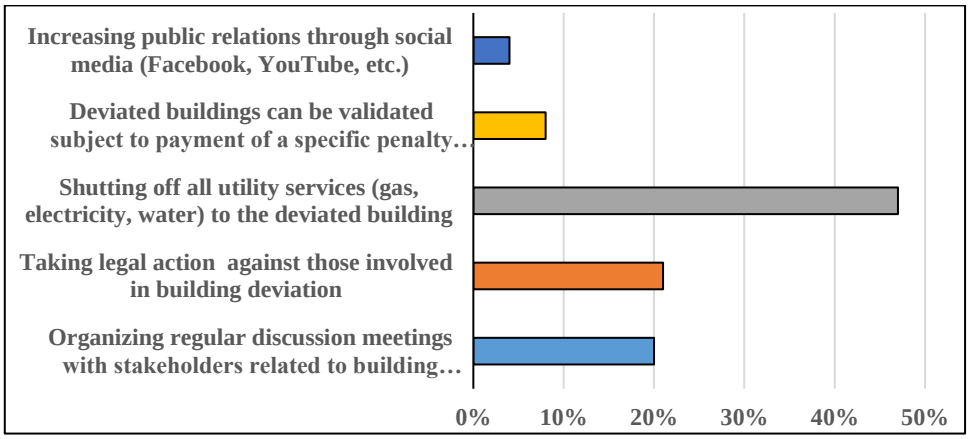

Figure 9. Measures which can play a role in preventing building construction deviations according to online respondents

In this instance, before validating the deviated building, the appropriate tests and evaluations must be carried out to ascertain whether it possesses adequate structural integrity and catastrophe tolerance. The remaining 4% of respondents place a strong emphasis on raising awareness of the negative consequences of building construction deviations on social media platforms like Facebook, YouTube, and others.

8. Conclusion

The Dhaka metropolitan area is seeing a rapid rate of urbanization, sometimes leading to the development of constructions without proper norms and regulations. For a variety of reasons, the relevant authority finds it difficult to guarantee planned development and appropriate oversight throughout building construction. Analyzing results and discussions, causes, and remedies of building construction deviation in the Dhaka metropolitan area regarding stakeholders' perception can be concluded as follows:

1. Analyzing the hierarchy indices, it is found that, "setback violation" is regarded as most severe building deviation by stakeholders among all the types.

2. According to on-field data, 74.19% of buildings in the study area violated the setback rule imposed by the government regardless of the varied demographic and spatial characteristics of the study areas.
3. According to 46% online respondents, obtaining utility services (gas, electricity, water) connection in the building without occupancy certificate acts as a major catalyst for building construction deviation.
4. Lack of required amount of manpower of development control wing of RAJUK is regarded as a serious constraint in preventing construction deviations in buildings according to 42% online respondents.
5. Violation of building construction laws and regulations by building owners/developers can cause building construction deviation and it is believed by 36% online respondents.
6. Priorities should be given on ensuring the accountability of the concerned building owner according to 54% online respondents. It can greatly reduce the malpractice of building construction deviation.
7. Among the total online questionnaire survey respondents, 47% respondents believe that shutting off all utility services (gas, electricity, water) to the deviated building can potentially be an effective measure against building construction deviation.

9. Recommendation

This study focuses on the perception of stakeholders towards the causes and remedies of building construction deviation in Dhaka Metropolitan. Along with the stakeholders' perceptions, some additional recommendations regarding building construction deviation are as follows:

1. Blacklisting professional engineers/architects in the RAJUKS's Electronic Construction Permitting System (ECPS) for a specific period of time for constructing buildings in violation of the law.
2. If a developer company constructs a building in violation of the approved design, its registration can be temporarily suspended.
3. All owners involved in the construction of a building can be enlisted online in ECPS. In such a situation, the owner/owners of the building whose construction has been deviated will not be granted any new building construction permit/design approval until the previous deviation is resolved as per the rules.

4. If a building inspector is found to have neglected their duty in addressing building construction deviations, disciplinary action will be taken in accordance with applicable government service regulations.
5. Bringing the relevant contractors or site engineer under proper training through a specific structured method and maintaining database like RAJUK ECPS professionals.
6. Utility service providers (gas, electricity, water, etc.) can be given access to RAJUK's ECPS for the purpose of monitoring the building's approved design/occupancy. Also, a "Shared Responsibility and Liability" model can be formed between the service providers and RAJUK so that before providing utility services to a building, the service provider can be sure whether the building has any construction deviations.
7. The number of heavy equipment used in evictions can be increased.
8. Committees based on roads, wards, or areas can be established to start a community public awareness campaign. Public relations can also be improved by disseminating documentaries on the negative consequences of building construction deviation on social media platforms like Facebook, YouTube, TV channels, etc.
9. Building construction deviations can be decreased by making construction laws and regulations more palatable to the public.
10. Awareness, responsibility, and adherence to existing laws and regulations related to building construction by all stakeholders (owners, developers, architects, and engineers), including RAJUK, can play an important role in preventing construction violations.

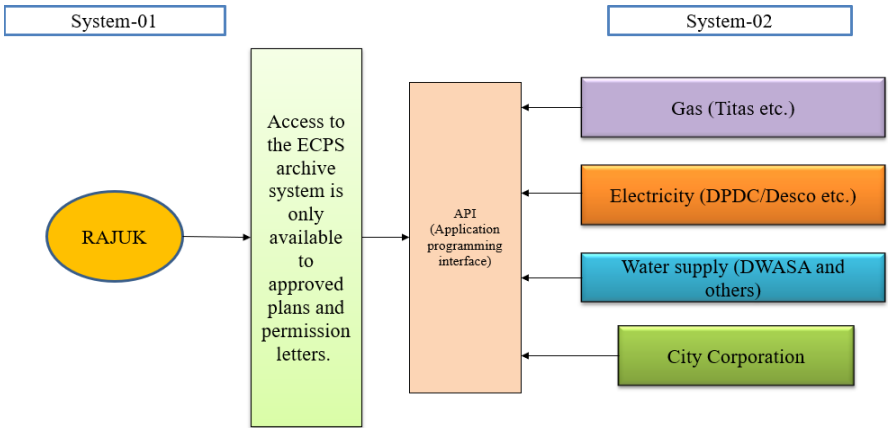

Figure 9. Shared responsibility and liability model

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