OPTIMAL RC BUILDING HEIGHTS IN DIFFERENT REGIONS OF BANGLADESH TO MITIGATE WIND LOAD IMPACT ACCORDING TO BNBC 2020

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ABSTRACT

Due to the rapid shifts in climate caused by global warming, the frequency of severe winds in the form of hurricanes and cyclones worldwide has escalated significantly in recent years. Consequently, the existing wind load calculations based on the BNBC 2006 provisions appear to be inadequate in the present day. The fundamental wind velocity has been reevaluated and raised under the current building code, BNBC 2020. Ignoring this revised wind velocity could result in extensive damage to buildings of various heights and footprints, ultimately leading to irreparable loss of human lives and property. Given that the BNBC 2020 designates distinct fundamental wind velocities for multiple districts in Bangladesh, it is imperative to establish a recommended maximum height limit for each region. This limit would explicitly indicate that constructing buildings exceeding this height without due regard for wind-induced loads would compromise their safety. The primary objective of this study is to determine the optimal building heights across Bangladesh, where gravity load considerations would suffice for secure and cost-effective designs. To accomplish this goal, a prototypical residential structure with a floor area of 1200 ft² serves as the basis. Various building heights are subjected to analysis using the Commercial ETABS software, applying wind loads according to the provisions outlined in BNBC 2020. The findings reveal that at a specific height, gravitational forces outweigh wind-induced loads, and this height is identified as the optimum for the corresponding region. A comprehensive table illustrating these optimal building heights for each region in Bangladesh has been formulated. This compilation not only offers readily available building height references for any part of Bangladesh but also empowers designers to make informed decisions about building heights that ensure economical designs while mitigating the predominant impact of wind loads.

Keywords:*Optimal Building Height, BNBC 2020, Wind Load Analysis, Gravity Load Design, Finite Element Analysis (FEA).*

1. INTRODUCTION

Throughout history, humanity has been captivated by the pursuit of reaching new heights, quite literally. From ancient pyramids to modern skyscrapers, our society has consistently expressed its energy and wealth through awe-inspiring and colossal structures. Today, skyscrapers stand as symbols of economic prowess and leadership, with nations vying to claim the title of the world's tallest building. This ceaseless quest for verticality has ushered in incredible opportunities for the construction industry.

The field of civil engineering has evolved significantly in response to this enduring fascination with height. The advent of advanced structural design and analysis software, coupled with sophisticated finite element analysis, has revolutionised the architectural landscape. Nonetheless, the widespread use of computer analysis alone does not resolve the challenges confronting the industry. A fundamental grasp of how structures behave when subjected to computational tools is a transformative element in the way we conceive, design, and construct buildings (Ahmed et al., 2015).

As buildings ascend to greater heights and become more slender, civil engineers increasingly face the formidable task of meeting prescribed drift requirements and mitigating the impact of structures on their surroundings. A variety of innovative concepts have been proposed and are now implemented in high-rise structures across the globe (Davenport et al., 1995).

The impact of critical wind forces on structures has, at times, resulted in extensive damage to various buildings, both large and small, often leading to irreplaceable loss of human life and property (Kim et al., 2016). To withstand moderate earthquakes and frequent wind loads, buildings must exhibit sufficient stiffness and elasticity to control displacement and prevent potential damage. Nevertheless, designing a structure that can withstand intense lateral wind loads is impractical due to the inherent damping of flexible structures. Consequently, it is possible to reduce strength requirements for specific elements, yielding more cost-effective structures. These properties typically provide ductility and toughness to prevent abrupt failure of brittle structures (Tanaka et al., 2012).

In addition to bearing all gravitational loads throughout a building's lifespan, a comprehensive support system should manage lateral forces effectively. Wind primarily affects buildings in two ways: it applies forces and moments to the structure and its cladding while also distributing air in and around the building, resulting in wind pressure (Saiful et al., 1990).

When designing high-rise buildings, engineers must consider both wind and seismic loads. According to the 2020 Bangladesh National Building Code (BNBC), when the wind acts on a building, causing both positive and negative pressures, the building must possess the necessary strength to withstand these pressures and transfer the load to the supporting structure and the ground through the foundation. Wind pressure depends on the basic wind speed, building height, internal pressure, building shape, and the region's topography.

The core objectives of this study are threefold: to conduct a comprehensive analysis of residential buildings with varying numbers of stories in response to wind loads, in adherence to BNBC 2020 standards; to closely observe the behaviour of such residential buildings under the influence of wind forces; and finally, to ascertain the ideal heights for reinforced concrete (RC) structures in various regions of Bangladesh, with the ultimate goal of mitigating the prevailing effects of wind loads and ensuring structural soundness.

The wind load calculation based on the BNBC 2006 appears to be inadequate in light of the revisions to the basic wind speed and its increase in the current BNBC 2020 building code. This oversight can result in significant damage to buildings of varying heights and layouts, posing a substantial risk to life and property. The efficient and cost-effective design of tall structures has become a formidable challenge for structural engineers.

Rapid urbanisation and economic growth have shifted the focus from low-rise buildings to high-rises, presenting a threat to national food security as arable land diminishes. To address this, vertical expansion has been prioritised over horizontal expansion. However, vertical structures necessitate careful consideration of wind loads to avoid irreversible damage (Cho et al., 2004). To establish an optimal height for buildings, civil engineers are required to follow certain guidelines to mitigate the effects of wind loads (Sinha, 1996).

Considering the diverse basic wind speeds in different districts of Bangladesh, as per BNBC 2020, it is crucial to impose a mandatory maximum height limit for each region. This limit would serve as a clear indication that buildings exceeding this height may not be safe without due consideration of wind-induced loading (Philip et al., 2014). This study aims to determine the ideal building heights for all of Bangladesh, where gravity load design suffices for safe and economical building design.

In this investigation, a typical residential building with a 1200-square-foot floor area has been analysed at various heights to prevent a slenderness ratio exceeding 10:1. The analysis was conducted using the commercial analytical software ETABS Ver. 2016, and wind loads were applied in accordance with BNBC 2020 provisions. The results indicate that, for a specific height, gravity load design supersedes wind load considerations, establishing this height as the maximum optimal height for this study.

2. METHODOLOGY

The wind code chosen for wind load design is specified after the parametric study has been performed. Next, structural analysis software is introduced. Different buildings are modelled with properties and dimensions of concrete material, structural components, and steel reinforcement specified. Subsequently, the assignation of permanent and import loads on the building model is clarified. The analysis results for the project are also discussed.

2.1 Comparison of Wind Speed

Prior to BNBC 2006, wind load calculations relied on a simple empirical formula that did not consider the influence of nearby structures and the height of the building on wind pressure. This limitation was addressed in BNBC 2006 with the introduction of exposure categories and the gust factor, which accounted for the effects of surrounding objects and building height. BNBC 2020 further improved these considerations. Wind loads in urban areas under BNBC 2020 were found to be notably higher than those under BNBC 2006. However, in the open, obstructed, and unobstructed land-type areas, the wind loads under BNBC 2020 were significantly lower than in BNBC 2006, as shown in Figures 1 and 2.

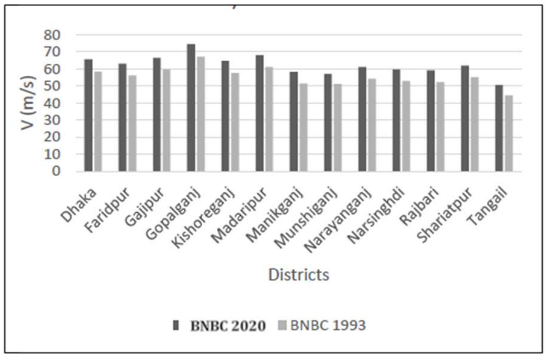

Figure 1: Wind Speed Comparison in Dhaka Division

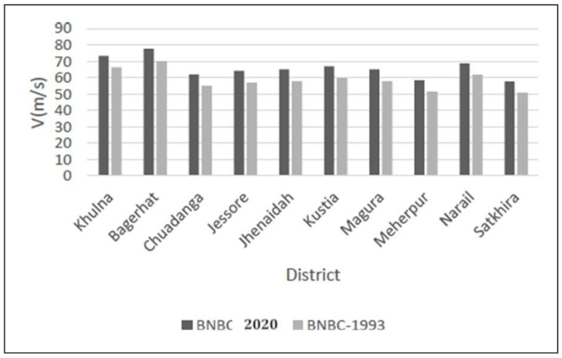

Figure 2: Wind Speed Comparison in Khulna Division

In Dhaka Division, the average wind speed was 55.5 m/s according to BNBC 2006, marking a 12.4% increase by 2020. Similarly, in Khulna Division, the average wind speed under BNBC 2006 was 58.7

m/s, with an increase of 12.1% by 2020. The Mymensingh Division experienced a 12.5% increase in wind speed from the 56.0 m/s recorded in BNBC 2006. Barisal Division saw its average wind speed rise by 10.9% from the BNBC 2006 value of 70.4 m/s. In Rajshahi Division, the average wind speed increased by 13.3%, from 48.5 m/s in BNBC 2006 to 2020. Sylhet Division recorded a 13.1% increase in wind speed from the BNBC 2006 value of 50.7 m/s. Rangpur Division witnessed a 13.3% increase in wind speed from the BNBC 2006 value of 47.3 m/s. Chottogram Division showed a 12.5% increase in the average wind speed from the BNBC 2006 value of 54.7 m/s.

The BNBC 2020 took into account the influence of nearby structures and building height. It introduced the concept of a 3-second gust to express the basic wind speed, in contrast to BNBC 2006's fastest mile wind speed. Furthermore, BNBC 2020 exhibits a more uniform rate of increase in wind load concerning the number of floors than BNBC 2006. The procedure for calculating the design wind pressure in BNBC 2020 differs substantially from that of BNBC 2006. BNBC 2020 introduced two new terms, topographic factor and directionality factor. All factors related to wind speed have undergone changes from BNBC 2006 to BNBC 2020. Under BNBC 2020, wind loads in exposure category A were notably higher, with a 7-12% increase compared to BNBC 2006, while exposure categories B and C experienced a significant decrease of 2-10% compared to BNBC 2006.

2.2 Project Details

2.2.1 Architectural Details

To investigate the behaviour of high-rise buildings, a typical residential building with a plan area measuring 36'×41' has been chosen. The plan and the 3d isometric view of the building is shown in Figures 3 and 4.

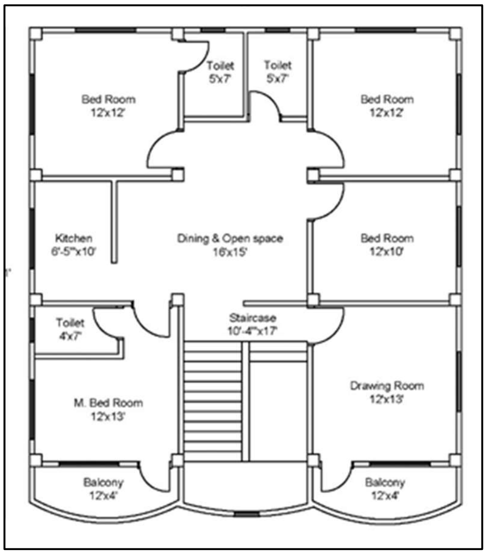

Figure 3: Floor Plan of the RC Building

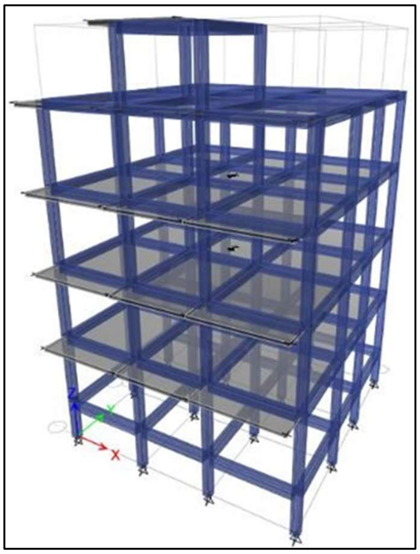

Figure 4: Model of the RC Building

2.2.2 General Design Considerations

A. Dimensions of Different Elements:

- Slab depth: 4.5 $inches$
- Wall thickness: 5 $inches$

B. Material Properties:

- Masonry unit weight: 120 pcf
- RCC unit weight: 150 pcf
- Steel unit weight: 490 pcf

- Steel grade: $60\ Grade\ (60{,}000\ psi)$
- Modulus of Elasticity for RCC: $57000 * \sqrt{f_c'}\ psi$
- Modulus of Elasticity for Steel: $29{,}000\ ksi$

C. Load Considerations:

- Dead load: Self-weight
- Live load for bedroom and toilet: $42\ psf$
- Live load for Dining & Balcony: $63\ psf$
- Live load for Staircase: $84\ psf$
- Live load for Roof: $20\ psf$
- Floor Finish: $20\ psf$
- Wind Load: As per BNBC 2020

D. Load Combinations:

I. Without considering Wind Load:

- $1.2D + 1.6L$

II. Considering Wind Load:

- $1.4D$
- $1.2D + 1.6L$
- $1.2D + (L\ or\ 0.8W)$
- $1.2D + 1.6W + L$
- $0.9D + 1.6W$

In the load consideration, D represents the Dead Load, L represents the Live Load, and W represents the wind or earthquake load.

2.3 Wind Factors

Lateral loads are defined in static load cases with various parameters, including exposure and pressure coefficients, wind exposure parameters, exposure height, wind coefficients, wind speed, terrain category, structure class, risk coefficient factor, topography factor, and more. These values are detailed as follows.

2.3.1 Surface Roughness

Exposure categories depend on wind directions, sectors, and surface roughness.

Surface Roughness A: Applies to urban and suburban areas, wooded areas, or terrains with numerous closely spaced obstructions.
Surface Roughness B: Suitable for open terrains with scattered obstructions, generally less than 9.1 meters in height.
Surface Roughness C: Applicable to flat, unobstructed areas and water surfaces outside cyclone-prone regions.

2.3.2 Exposure Types

Exposure A: Used when the ground surface roughness corresponds to Surface Roughness A.
Exposure B: Applied when Exposure A or C conditions are not met.
Exposure C: Used when the ground surface roughness matches Surface Roughness C.

For this analysis, exposure type B, representing open terrain with scattered obstructions generally less than 9.1 meters in height, has been chosen.

2.3.3 Importance Factor

According to BNBC 2020, the importance factor for residential buildings is set at 1, a parameter retained in this analysis.

2.3.4 Topographic Factor

The topographic factor, K_{zt}, accounts for wind speed-up effects and is calculated using the formula:

$$K_{zt} = (1 + K_1 K_2 K_3)^2 \tag{1}$$

If the site conditions and structural locations do not meet the conditions specified in Section 2.4.7.1 (BNBC 2020), then K_{zt} equals 1.0. However, if the site conditions and structure locations do not meet the criteria specified in section 2.4.7.1 of BNBC 2020, K_{zt} is considered as 1.0 for this analysis.

2.3.5 Gust Effect Factor

Rigid Structures: For rigid structures, as defined in Section 2.1.3, the gust-effect factor is either 0.85 or calculated using the formula (6.2.6 to 6.2.9) per BNBC 2020.

Flexible or Dynamically Sensitive Structures: For flexible or dynamically sensitive structures, as defined in Section 2.1.3, the gust-effect factor is calculated using the formula (6.2.10 to 6.2.16) as per BNBC 2020.

For rigid structures, as defined in Section 2.1.3, the gust-effect factor is taken as 0.85 or calculated using the formula (6.2.6 to 6.2.9) as per BNBC 2020.

2.3.6 Velocity Pressure

The velocity pressure, q_z, evaluated at height z, is calculated using the equation:

$$q_z = 0.000613 K_z K_{zt} K_d V^2 I \ (in\ kN/m^2) \tag{2}$$

Here, K_z represents the wind directionality factor, K_{zt} is the velocity pressure exposure coefficient, K_d is the topographic factor, V is the wind velocity in m/s, and I is the structural importance factor.

2.3.7 Pressure Coefficient

Internal Pressure Coefficient: The internal pressure coefficient, GC_{pi}, is determined from Figure 6.2.5 based on building enclosure classifications as specified in Section 2.4.9.

External Pressure Coefficient: There are two systems for external pressure coefficients:

- **Main Wind-Force Resisting Systems:** External pressure coefficients (C_p) are provided in Figures 6.2.6 to 6.2.8. Combined gust effect factor and external pressure coefficients (GC_{pf}) are detailed in Figure 6.2.10 for low-rise buildings. The pressure coefficient values and gust effect factor in Figure 6.2.10 should not be separated.
- **Components and Cladding:** Combined gust effect factor and external pressure coefficients for components and cladding (GC_p) are given in Figures 6.2.11 to 6.2.17. The pressure coefficient values and gust effect factor should not be separated.

2.3.8 Wind Directionality Factor

The directionality factor, K_d, is calibrated in combination with loads specified in Section 2.7 and is applied only when used in conjunction with load combinations specified in Sections 2.7.2 and 2.7.3.

2.4 Column Layouts with Consecutive Steel Areas

The column layout, along with the required steel areas for each column at different cross-sections, including sections A, B, C and D of the building, is shown in Figures 5, 6, 7 and 8.

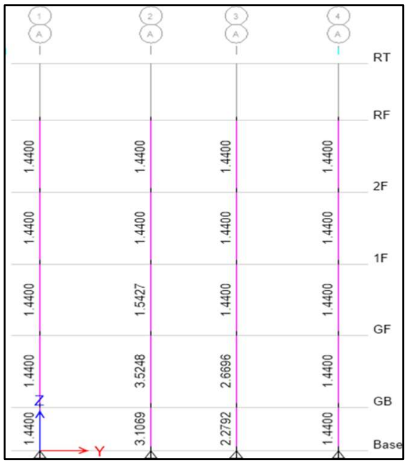

Figure 5: Area of steel in section A

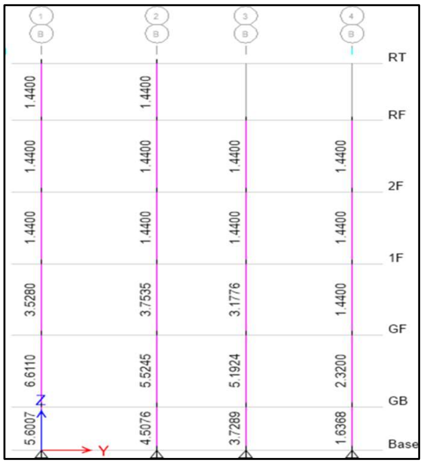

Figure 6: Area of steel in sectionB

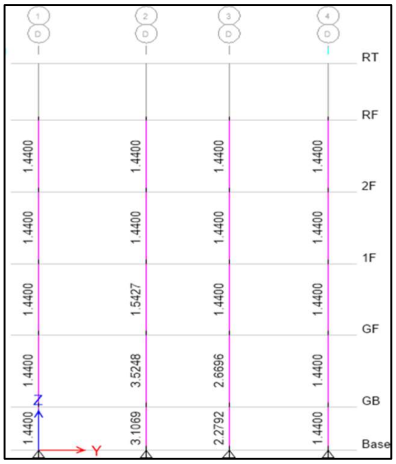

Figure 7: Area of steel in sectionC

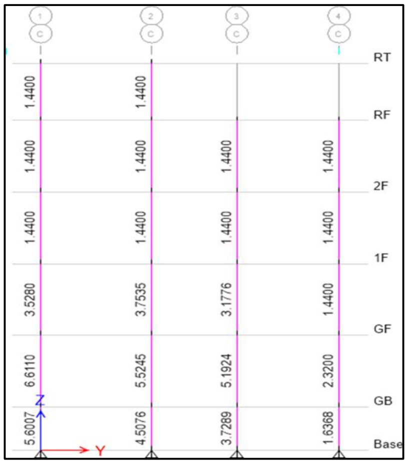

Figure 8: Area of steel in sectionD

3. RESULTS AND DISCUSSIONS

3.1 General

The analysis has been conducted using two distinct approaches. In the first method, a standard 12×12 in^2 column was chosen for all the buildings with varying numbers of stories, and the corresponding total steel requirement was determined in response to wind effects. Subsequently, a graph was plotted to visualise the relationship between the amount of steel required and the number of stories to identify the maximum height at which gravity load predominates over wind load.

In the second method, the percentage of steel requirement was fixed for different column sizes. This method aimed to establish the correlation between column cross-sectional area and story height to determine the optimal height at which a proportional increase in column cross-sectional area occurs. Once it was observed that the column cross-section increased significantly due to wind effects, it was considered an indication of wind playing a dominant role in lateral loads.

3.2 First Method of Analysis

In a 4-story building, the column's longitudinal reinforcement showed the effect of wind from ETABS analysis, as shown in Table 1, leading to a total reinforcement requirement of 193.54 in^2 due to wind load, as presented in Table 2. The total column cross-section was 12096 in^2, resulting in a required total

Table 1: Categorising All the districts According to Their Wind Speed

Category	**Wind Speed (m/s)**	**District**
Category-1	41.1-45	Dinajpur, Chapainababganj, Thakurgaon, Panchagar, and Nilphamari
Category-2	45.1-49	Angarpota and Dahagram
Category-3	49.1-52	Rajshahi, Sirajganj, Chandpur, Srimangal, Tangail, and Lakshmipur
Category-4	52.1-55	Moulvibazar and Hobiganj
Category-5	55.1-59	Noakhali, Brahmanbaria, Jaypurhat, Jamalpur, Khagrachari, Manikganj, Meherpur, Munshiganj, Naogaon, Rangamati, and Satkhira
Category-6	59.1-63.5	Sylhet, Bandarban, Bogra, Chuadanga, Cumilla, Faridpur, Narayanganj, Narshingdi, Natore, Pabna, Rajbari, Sariatpur, Sherpur, and Sunamganj
Category-7	63.6-66	Dhaka, Feni, Gaibandha, Gazipur, Jessore, Jenidaha, Kishoreganj, Kurigram, Kushtia, Magura, Netrokona, Rangpur, and Lalmonirhat
Category-8	66.1-71	Mymensing, Bhola, Madanipur, Narail, Ishurdi, Gazipur, and Kushtia
Category-9	71.1-75	Khulna and Gopalganj
Category-10	75.1-79	Barishal and Bagerhat
Category-11	79.1-80	Chottogram, Barguna, Cox's Bazar, Hatiya, Jalkathi, Kutubdia, Maheshkhali, Patuakhali, Pirojpur, St. Martin Island, Sandwip, and Teknaf

Table 2: Area (in^2) for Different Wind Speed Category Zone

No. of Story	**Area of steel (in^2)**										
	Category-1	**Category-2**	**Category-3**	**Category-4**	**Category-5**	**Category-6**	**Category-7**	**Category-8**	**Category-9**	**Category-10**	**Category-11**
1	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84
2	74.88	75.63	75.63	76.38	76.38	75.63	78.62	75.63	75.63	75.63	75.4
3	99.88	100.86	100.86	101.84	101.84	100.86	107.71	105.75	128.28	161.57	174.5
4	127	130.64	130.64	128.22	135.48	157.25	193.54	210.47	266.11	368.93	392.84
5	158.4	158.4	158.4	192.96	236.16	282.24	348.48	403.2	515.52		
6	195.44	227.17	242.21	304.01	384.19	472.72	589.65				
7	243.2	342.15	374.47	480.91	613.97						
8	362.3	515.75	556.24								
9	590.4										

Table 3: Percentage of steel (%) for Different Wind Speed Category Zone

No. of Story	**% of Steel**										
	Category-1	**Category-2**	**Category-3**	**Category-4**	**Category-5**	**Category-6**	**Category-7**	**Category-8**	**Category-9**	**Category-10**	**Category-11**
1	1	1	1	1	1	1	1	1	1	1	1
2	1	1.01	1.01	1.02	1.02	1.01	1.05	1.01	1.01	1.01	1.01
3	1.02	1.03	1.03	1.04	1.04	1.03	1.1	1.08	1.31	1.65	1.78
4	1.05	1.08	1.08	1.06	1.12	1.3	1.6	1.74	2.2	3.05	3.25
5	1.1	1.1	1.1	1.34	1.64	1.96	2.42	2.8	3.58		
6	1.17	1.36	1.45	1.82	2.3	2.83	3.53				
7	1.28	1.8	1.97	2.53	3.23						
8	1.7	2.42	2.61								

9	2.5

steel percentage of 1.6%, as shown in Table 3. Similar analyses were conducted for other stories in the region, and a graph was plotted to determine that up to a 3-story building (30 feet) could be constructed where gravity load dominates over wind load. Similar analyses were performed in various regions to find the optimum height.

3.3 Second Method of Analysis

In the second method of analysis, different column section types were selected, and the total column reinforcement percentage was kept constant, as presented in Table 4. Various stories were analysed by increasing the column cross-section size to maintain a consistent total percentage of steel in each Story under the influence of wind load. The analysis was conducted to determine the optimal height, shown in Figures 9 and 10. Table 5 represents theoptimum height of buildings at different locations in Bangladesh, also plotted on a map, which is presented in Figure 11.

Table 4: Column Dimensions and Column Sizes (in^2) for Different Wind Speed Category Zone

No. of Story	**Column Dimension**					**Column Size (in^2)**				
	Category-1 & 2	**Category-3 & 4**	**Category-5 & 6**	**Category-7 & 8**	**Category-9, 10 & 11**	**Category-1 & 2**	**Category-3 & 4**	**Category-5 & 6**	**Category-7 & 8**	**Category-9, 10 & 11**
1	9×10	9×10	10×10	10×10	11×11	90	90	100	100	121
2	10×10	10×10	10×11	10×11	12×12	100	100	110	110	144
3	10×11	10×11	11×12	11×12	13×16	110	110	132	132	208
4	11×11	11×12	12×12	13×14	14×18	121	132	144	182	252
5	11×12	12×13	12×16	14×18	15×20	132	156	192	252	300
6	12×13	12×15	14×17	16×20		156	180	238	320	
7	13×13	14×18	14×20			169	252	280		
8	15×15	16×20				225	320			
9	15×20					300				

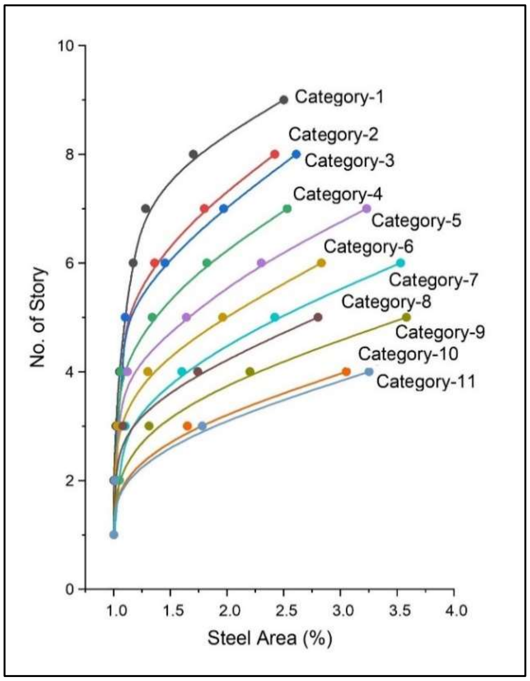

Figure 9: No. of Story vs Steel Area for Different Wind Speed Category Zone According to First Method of Analysis

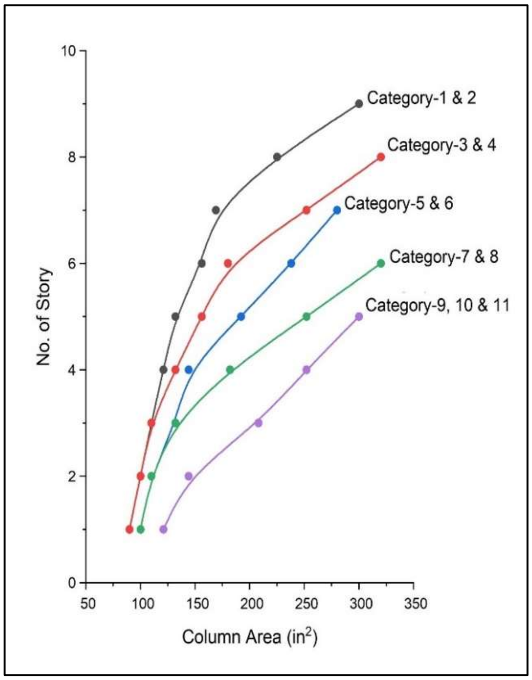

Figure 10: No. of Story vs Column Area for Different Wind Speed Category Zone According to Second Method of Analysis

Table 5: The Optimum Height of Buildings at Different Locations in Bangladesh

District Name	Wind Speed (m/s)	Optimum Height (ft)	District Name	Wind Speed (m/s)	Optimum Height (ft)
Angarpota	47.8	60	Madaripur	68.1	30
Bagerhat	77.5	20	Magura	65	30
Bandarban	62.5	40	Manikanj	58.2	40
Barguna	80	20	Meherpur	58.2	40
Barisal	78.7	20	Maheshkhali	80	20
Bhola	69.5	30	Moulvibazar	53	50
Bogra	61.9	40	Munshiganj	57.1	40
Brahmanbaria	56.7	40	Mymensingh	67.4	30
Chandpur	50.6	50	Naogaon	55.2	40
Chapai Nawabganj	41.4	70	Narail	68.6	30
Chittagong	80	20	Narayanganj	61.1	40
Chuadanga	61.9	40	Narsinghdi	59.7	40
Comilla	61.4	40	Natore	61.9	40
Cox’s Bazar	80	20	Netrokona	65.6	30
Dahagram	47.8	60	Nilphamari	44.7	70
Dhaka	65.7	30	Noakhali	57.1	40
Dinajpur	41.4	70	Pabna	63.1	40
Faridpur	63.1	40	Panchagarh	41.4	70
Feni	64.1	30	Patuakhali	80	20
Gaibandha	65.6	30	Pirojpur	80	20
Gazipur	66.5	30	Rajbari	59.1	40
Gopalganj	74.5	30	Rajshahi	49.2	50
Habiganj	54.2	50	Rangamati	56.7	40
Hatiya	80	20	Rangpur	65.3	30
Ishurdi	69.5	30	Satkhira	57.6	40
Jamalpur	56.7	40	Shariatpur	61.9	40
Jessore	64.1	30	Sherpur	62.5	40
Jhalakati	80	20	Sirajganj	50.6	50
Jhenaidah	65	30	Srimangal	50.6	50
Khagrachhari	56.7	40	St. Martin’s Island	80	20
Khulna	73.3	30	Sunamganj	61.1	40
Kutubdia	80	20	Sylhet	61.1	40
Kishoreganj	64.7	30	Sandwip	80	20
Kurigram	65.6	30	Tangail	50.6	50
Kushtia	66.9	30	Teknaf	80	20
Lakshmipur	51.2	50	Thakurgaon	41.4	70
Lalmonirhat	63.7	30			

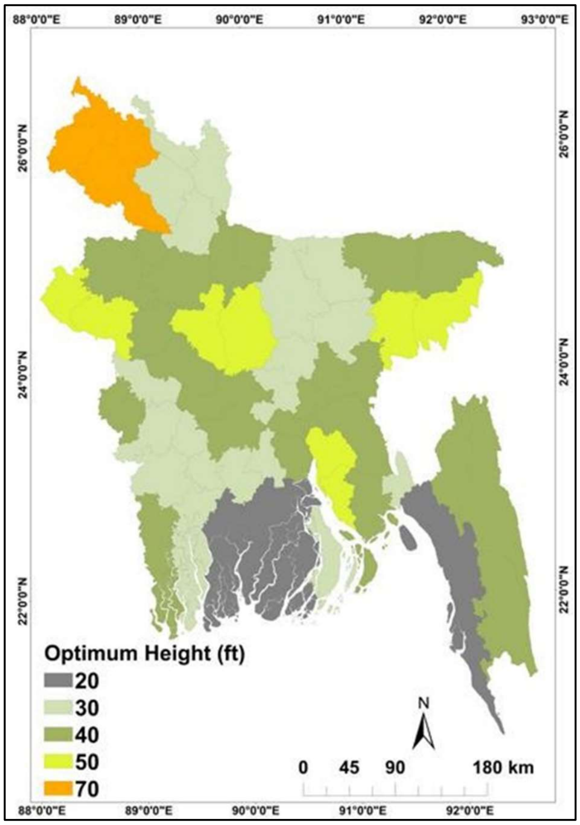

Figure 11: Map of Bangladesh Showing the Optimum Height at Different Locations

4. CONCLUSIONS

The study investigated the response of a residential building to both gravity and wind loads in accordance with the BNBC 2020 guidelines. The building was meticulously modelled and analysed using ETABS 16 software. The analysis revealed that in certain districts, including Dhaka, Feni, Gaibandha, Gazipur, Jessor, Jenidaha, Kishoreganj, Kurigram, Kushtia, Magura, Netrokona, Rangpur, Lalmonirhat, Mymensingh, Bhola, Madanipur, Narail, Issurdi, Khulna, Gopalganj, Gazipur, and Kustia, the construction of up to 3-story buildings can proceed without any significant impact from wind loads. These structures can be adequately designed solely considering gravity loads.

However, beyond three stories in these districts, it becomes imperative to account for the dominant influence of wind loads, as the total steel requirements escalate substantially due to these loads. Similarly, in districts such as Chottogram, Barguna, Coxs Bazar, Hatiya, Jalkathi, Kutubdia, Maheshkhali, Patuakhali, Pirojpur, St. Martin Island, Sandwip, Teknaf, Barishal, and Bagerhat, buildings up to 2 stories can be constructed without significant wind load considerations. Above this threshold, wind loads must be factored in due to the rapid increase in steel requirements or the necessity to enhance column cross-sections to mitigate the wind effect.

In districts including Noakhali, Brahmanbaria, Jaypurhat, Jamalpur, Khagrachari, Manikganj, Meherpur, Munshiganj, Naogaon, Rangamati, and Satkhira, the optimal building height is determined to be 40 feet or four stories. Within this range, wind loads are not a dominant factor. In Agarpota and Dahagram, it is feasible to construct buildings with up to 6 stories, as wind loads do not exert a dominant influence within this height range. On the other hand, in districts such as Dinajpur, Chapainababganj, Thakurgaon, Panchagar, and Nilphamari, the construction of buildings with up to 7 stories is viable without considering the dominant effects of wind loads. This is the maximum story height achievable in these regions due to their relatively low wind speeds, resulting in reduced wind load impacts.

The table presented summarises the optimal building heights for various regions in Bangladesh, facilitating easy reference for building design across the country. It aids designers in making informed decisions regarding building heights while minimising the influence of wind loads.

It's important to note that this analysis was conducted for a specific floor area of 1200 ft^2. Variations in floor area may yield different results. Additionally, the analysis assumed constant factors related to wind, such as wind coefficients, terrain category, structure class, risk coefficient factor, topography factor, wind directionality factor, and exposure type. In practice, these coefficients may vary by geographic location, potentially yielding different analysis outcomes. Therefore, this analysis is applicable to specific scenarios.

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