A COMPARATIVE STUDY ON EFFECTS OF LATERAL LOADS ON RESIDENTIAL STRUCTURES AT DIFFERENT ZONES OF BNBC, WITH THE PRESENCE OF SHEAR WALL AT DIFFERENT LOCATIONS

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A thesis submitted to the Department of Civil Engineering of Sonargaon University (SU) in partial fulfillment for the degree of Bachelor of Science in Civil Engineering



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Sonargaon University (SU)
147/I Green Road, Dhaka-1215, Bangladesh
Section: 22B
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BOARD OF EXAMINERS

The thesis titled “A Comparative Study on Effects of Lateral Loads on Residential Structures at Different Zones of BNBC, With the Presence of Shear Wall at Different Locations” Md. Hiron Mia (ID: CE2101022001), Md. Alauddin (ID: CE2101022038), Md. Shah Alam (ID: CE2101022045), Md. Jaker Hossain (ID: CE2101022107), Md. Imran Mridha (ID: CE2101022159), has been accepted as satisfactory in partial fulfillment on date of defense.

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It is hereby declared that this thesis/project or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

Bangladesh is located in a seismically active area. The ground shakes during an earthquake. As a result, the base of a building sitting on it will move. So it is necessary to ensure the adequacy of the structures against the horizontal load effect. With the help of BNBC's guidelines, the risk of failure in newly built infrastructure exposed to wind and earthquakes can be minimized. The latest BNBC code is Bangladesh National Building Code 2020 (BNBC 2020). In BNBC-2020, the seismic zone of Bangladesh has been divided into categories, such as Zone-I (seismic intensity: low), Zone-II (seismic intensity: moderate), Zone-III (seismic intensity: severe), and Zone-IV (seismic intensity: very severe). They have different seismic coefficients. This paper compares different seismic zone analyses of a multi-storeyed (G+9) residential building in all four seismic zones with and without shear wall. This paper's primary goal is to examine how this building responds to earthquakes in the updated seismic zone and coefficient and the effects of the shear wall location. The analyses. For different zones, wind speed and the seismic coefficient have been changed, and it mainly impacts the buildings. To compare these impacts based on environmental loads, we used four different locations in four different seismic zones. The locations of the different zones are Rajshahi (Zone-1), Dhaka (Zone-2), Rangpur (Zone-3), and Sylhet (Zone-4). Structural analysis is done by using ETABS (Extended Three-Dimensional Analysis of Building Systems) and compare the storey displacement, drift, stiffness etc. The results shows that the using of shear wall has an impact on design and stability of the structure.

Keywords: Shear wall, Seismic zone, Base shear, Drift, Stiffness, Storey Displacement.

NOTATION

BNBC = Bangladesh National Building Code

Z = Seismic Zone

I= Structural Importance

R= Response factor

T= Time period

V= Base shear

EQX= Earthquake in X-direction

EQY= Earthquake in Y-direction

WX= Wind in X-direction

WY= Wind in Y-direction

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CHAPTER - I

INTRODUCTION

1.1 General

Bangladesh is a developing country. Our economic is increasing day by day. Our construction arena is progressing with our economic. Some of large constructions are built in this country in a recent era. In spite of construction growth, we need to consider the tectonic geometry of beneath the country.

An earthquake is a shaking of the ground caused by the sudden breaking and movement of large sections (tectonic plates) of the earth's rocky outermost crust. The edges of the tectonic plates are marked by faults (or fractures). Most earthquakes occur along the fault lines when the plates slide past each other or collide against each other. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities. Hence, structure in such locations need to be suitably designed and detailed ensure stability, strength and serviceability with acceptable levels of safety under seismic effect.

Bangladesh is positioned at the juncture of several active tectonic plate boundaries. Moreover, it sits a top of the world’s largest river delta at close to sea level, facing both the risk posed by a quake and secondary risks of tsunamis and flooding in the quake’s aftermath (Seeber, 2012). Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is suited adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past. Bangladesh is surrounded by a number of tectonic blocks which have produced earthquakes in recent times. The present generation of people in Bangladesh hasn't witnessed any major earthquake. As a result, the population has been generally complacent about the risk of earthquakes. During the last seven or eight years, the occurrence and damage caused by some earthquakes (magnitude between 4 and 6) inside the country or near the country's border, has raised the awareness among the general people and the government as well. However, occurrences of earthquakes both inside and outside of the country and around major cities indicate that earthquake hazard exists for the country in general and the cities in particular. Consideration of earthquake forces in structural design, city planning and infrastructure development is therefore a prerequisite for future disaster mitigation (American Museum of Natural History, 2013)[1]. Geographically Bangladesh is located close to the two subduction zones created by two active tectonic plates: the Indian plate and the Eurasian plate. Moreover, the country is surrounded by the Himalayan Arc, the Shillong Plateau and the Dauki fault system in the north, the Burmese Arc and Arakan Yoma Anticlinorium in the east, and the Naga Disang Haflong thrust zone in the northeast (Ali M.H , 1998)[2]. The capital city is vulnerable to the earthquake as the country is in an active region in terms of vertical and horizontal movement of tremor.

1.2 Background of the study

Bangladesh is an earthquake prone country. So, all building must be earthquake resistant with proper planning and structural design. In BNBC 2006, the total area of the Bangladesh has been divided into three earthquake zones such as Zone-I, Zone-II and Zone-III. According to probable magnitudes of earthquake, Bangladesh has been divided into four seismic zones, namely major damage zone, moderate zone, minor zone and negligible zone (BNBC, 2020). But based on the severity of the probable intensity of the seismic ground motion and damages, Bangladesh has divided into four seismic zones i.e. Zone - 1, Zone - 2, Zone - 3 and Zone - 4.

Several studies have been carried out on seismic action in various aspects by different researches. But very few studies have been carried out on shear wall locations effects due to seismic load in Bangladesh. The seismic risk and construction cost of a same building analyzed and designed for different zones in Bangladesh followed by BNBC,1993 (Choudhury J.R, 1993)[3]. Very limited of studies have been done on this aspect. It needs to be explored to design earthquake resistant building and find out the required quantity of materials for four seismic zones in Bangladesh.

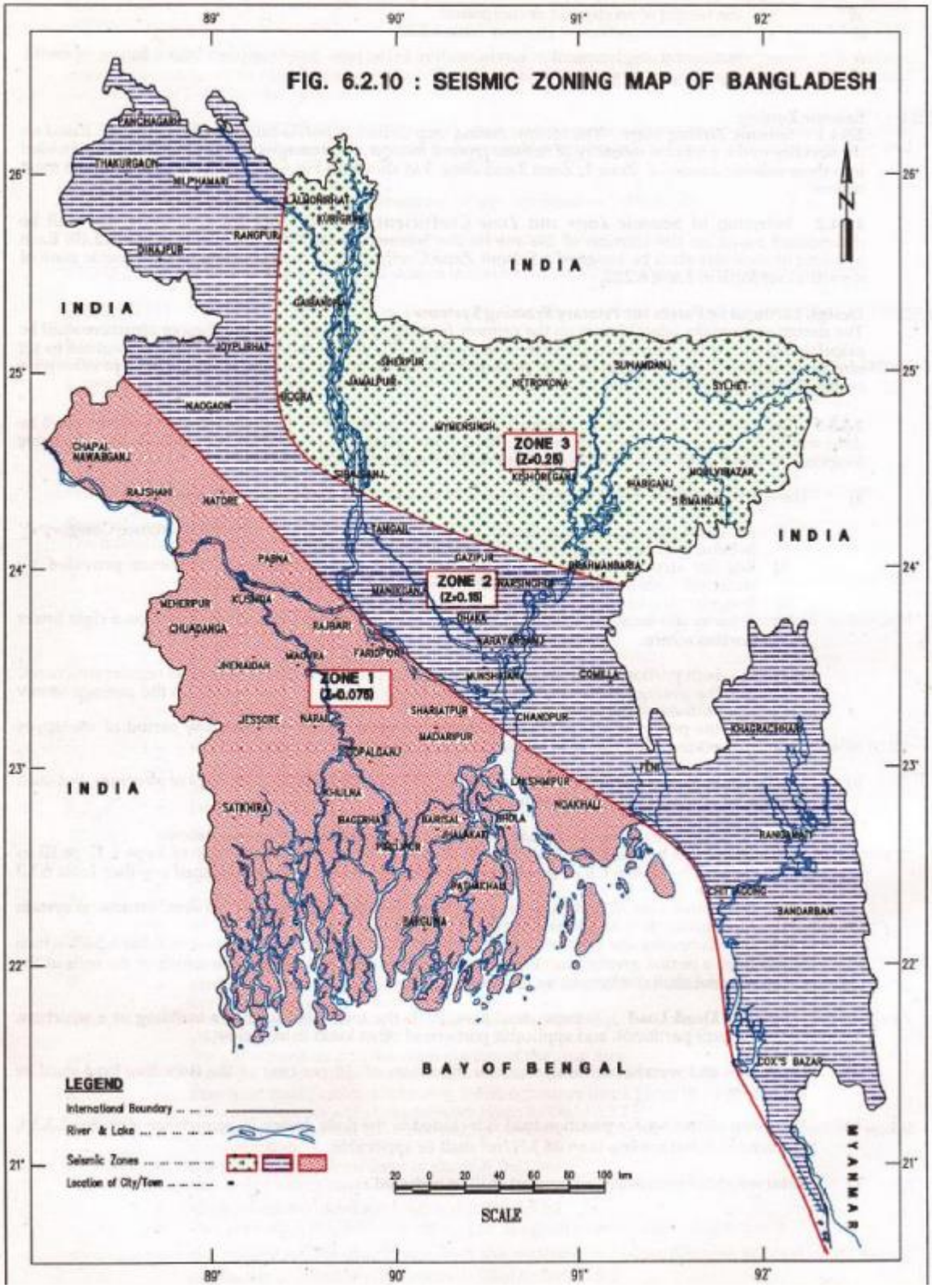


Figure 1.1: Seismic Zoning map in BNBC 2006

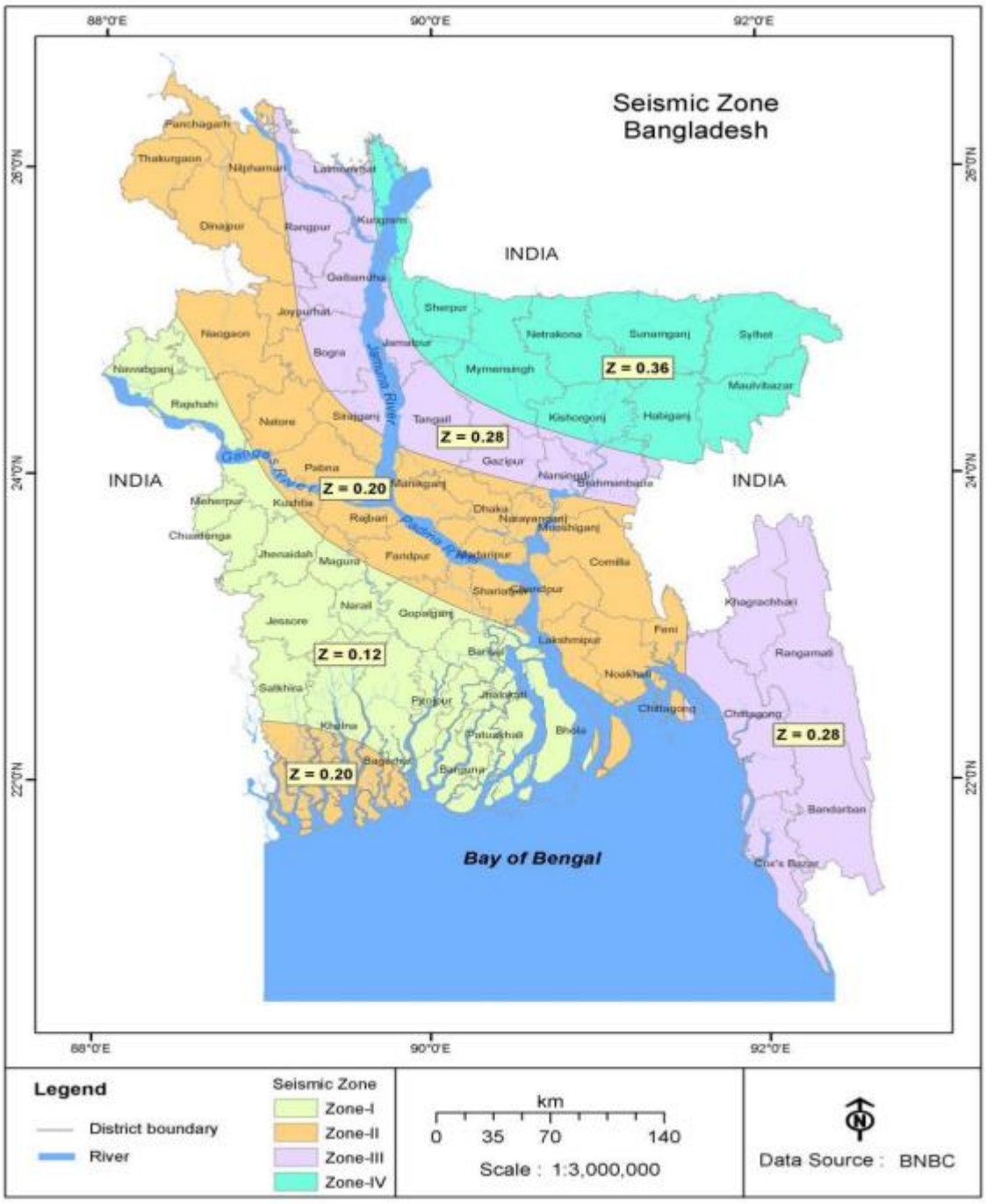


Figure 1.2: Seismic zoning map BNBC 2020

1.3 Objectives of the study

This research work is aimed at the overall study of the effects of the seismic zones on the high-rise buildings with or without the shear walls. These things lead to the following specific objectives:

(i) To identify the effects of the zones co-efficient on the high-rise buildings in different parameters without shear wall

(ii) To identify the effects of the zones co-efficient on the high-rise buildings in different parameters with shear wall in the lift core area.

(iii) To identify the effects of the zones co-efficient on the high-rise buildings in different parameters with shear wall in lift core area, staircase and the outer corner.

(iv) To compare the data of different parameters of the high-rise building among the structure with and without shear wall.

1.4 Outline of the study

This study has been conducted by considering approximately 3200 square feet (80ft x 40ft) layout plan of intermediate dual framing concrete structures. For structural analysis and design of this building under seismic considerations frame will consider as an intermediate reinforced concrete structure (dual system). Elevation of the building is considered G+9 that means ten (10) storied building. The structure will firstly analysis without shear walls i.e. column supported structure in the four seismic zones. Then the same structure will introduce with shear wall only in the lift core area in the four seismic zones then the parameters like drift ratio, stiffness, displacement will be considered of the structure. Again, the same structure will analysis with the shear wall in the outer periphery area and the effects will be record and finally will compare the results among the structured considered the location of the shear wall and the seismic zones. Architectural drawing and detailing will prepare by Auto CAD. Structural analysis and design of this structural will be carried out by ETABS - 2016 software. Structural drawing and seismic detailing also will be prepared by Auto CAD. MS Excel will be used to find out the analysis results. Comparative study will be carried on the structural frames such as beams and columns, shear walls among four seismic zones. All of this comparison will be presented graphically

Chapter II

LITERATURE REVIEW

2.1 General

Bangladesh is a moderately seismic region. It is a known fact that earthquakes do not occur just anywhere. It tends to cluster around defined areas or lines. Bangladesh and its adjoining areas are situated in the northeast part of the Indian subcontinent where earthquakes frequently occur. This region lies along the border of Eurasian and Indo- Australian plates. The Plate Tectonic theory states that the earth's crust is composed of plates which move relative to one another because of natural forces acting on these plates. Ninety percent earthquakes occur along the boundary of these tectonic plates. Earthquake also occurs due to volcanic eruption, manmade activities such as reservoir induced, excavation; mining etc. This chapter reviews the seismic environment prevailing in Bangladesh as a part of the evaluation of seismic risk. Important tectonic features of Bangladesh and evolution of seismic zoning maps are also discussed. Short description of some historical earthquakes and some recent earthquakes are also presented. Structural system, seismic design philosophy, seismic detailing and seismic effect reduction technology are also discussed here.

2.2 Literature Review

Several studies have been carried out on seismic action in various aspects by different researches. But very few studies have been carried out on shear wall's location effects due to seismic load in Bangladesh. The seismic risk and construction cost of a same building analyzed and designed (Rahman, 2011)[4] for different zones in Bangladesh followed by Bangladesh National Building Code (BNBC, 1993). Bangladesh has divided into four seismic zones according to BNBC - 2020 which was only three zones in previous BNBC. Present study will be carried out for a comparative study on effects of the shear location in the same structure for four seismic zones in Bangladesh will be followed by BNBC - 2020. Very limited of studies have been done on this aspect. It is helpful to an engineer to know the difference for a same structure in different seismic zones. Various researches carried out on seismic action are given below: (Huang, 2005)[5] carried out research for seismic loss estimation for Syhlet city. Objective of the study was improving our understanding of seismic risk and supporting enforcement of seismic provisions of building codes. (Haque, 2007)[6], carried out a relationship between earthquake intensity and attenuation for Bangladesh and its surrounding area. The objective of this study was to find out re-estimate the earthquake intensity of major historical earthquake of Bangladesh on EMS and develop a relationship between intensity - attenuation for Bangladesh and its surrounding area. (Sharfuddin, 2001)[7], conducted research work on earthquake hazards analysis for Bangladesh. The objective of the research work was to develop a homogeneous and complete earthquake catalogue and seismic hazard map.

CHAPTER –III

METHODOLOGY

3.1 Introduction

This chapter includes the design procedure of the structures at different seismic zones in the Bangladesh with a specific plan of a structure. The structure will analyze according to BNBC (Bangladesh National Building Code) 2020 gazette version of the building code in the Bangladesh. In the analysis we will follow the coefficients of wind effects and obviously earthquake factors depending on the height and zones coefficients.

3.2 Plan and Story of the Structure

In this study we have chosen a typical building structure plan for analyze. The plan is regular in shape and the plan consists of approximately 3200 square feet area. The plan contains a ground floor plan for using parking and other floor are typical for living. The story of the structure is considering as high-rise building of ten (10) storied as we mention it G+9 storied building. The typical plan is shown following:

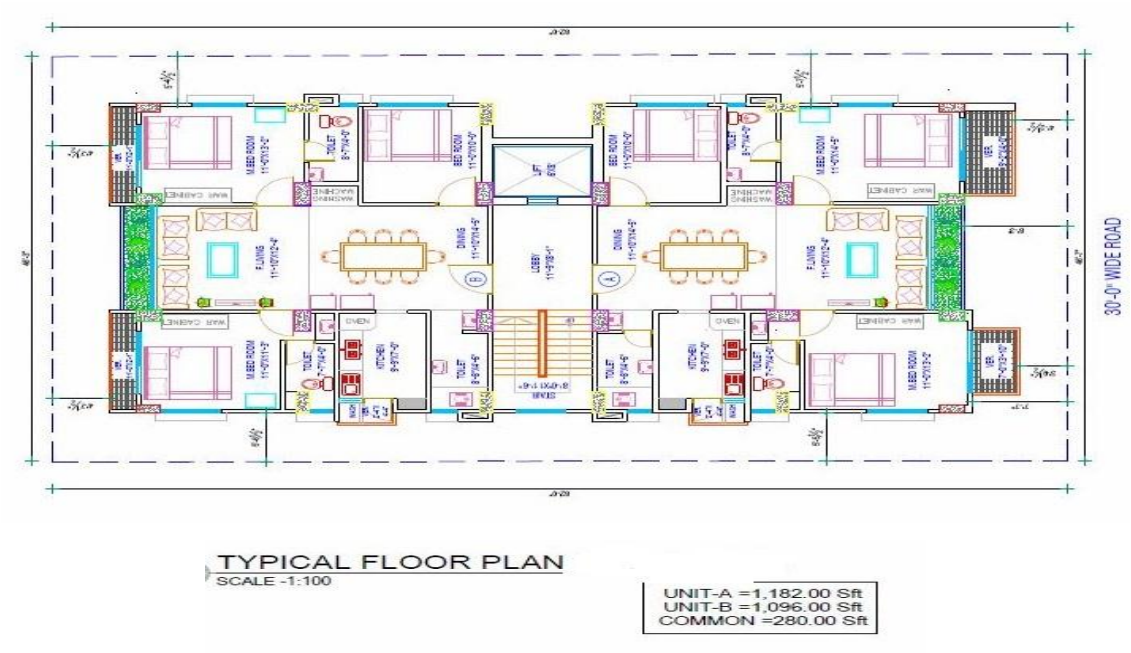


Figure 3.1: Typical floor plan

3.2.1 Floor Plan with Shear Wall

This structure is introduced with shear wall at the lift core area and the outer area. The shear wall is the essential structural element to increase the stiffness of the structure and control the drift of the structure. Shear wall also help the structure to resist the eccentricity of the structure. The common practice of the shear wall design is placed the shear wall at the lift core area. But the shear wall can be placed the any other area of the structure where it is needed. The structure we analyze in the study we placed the shear wall in different areas and compare the result. The following plan shows the position of the structure.

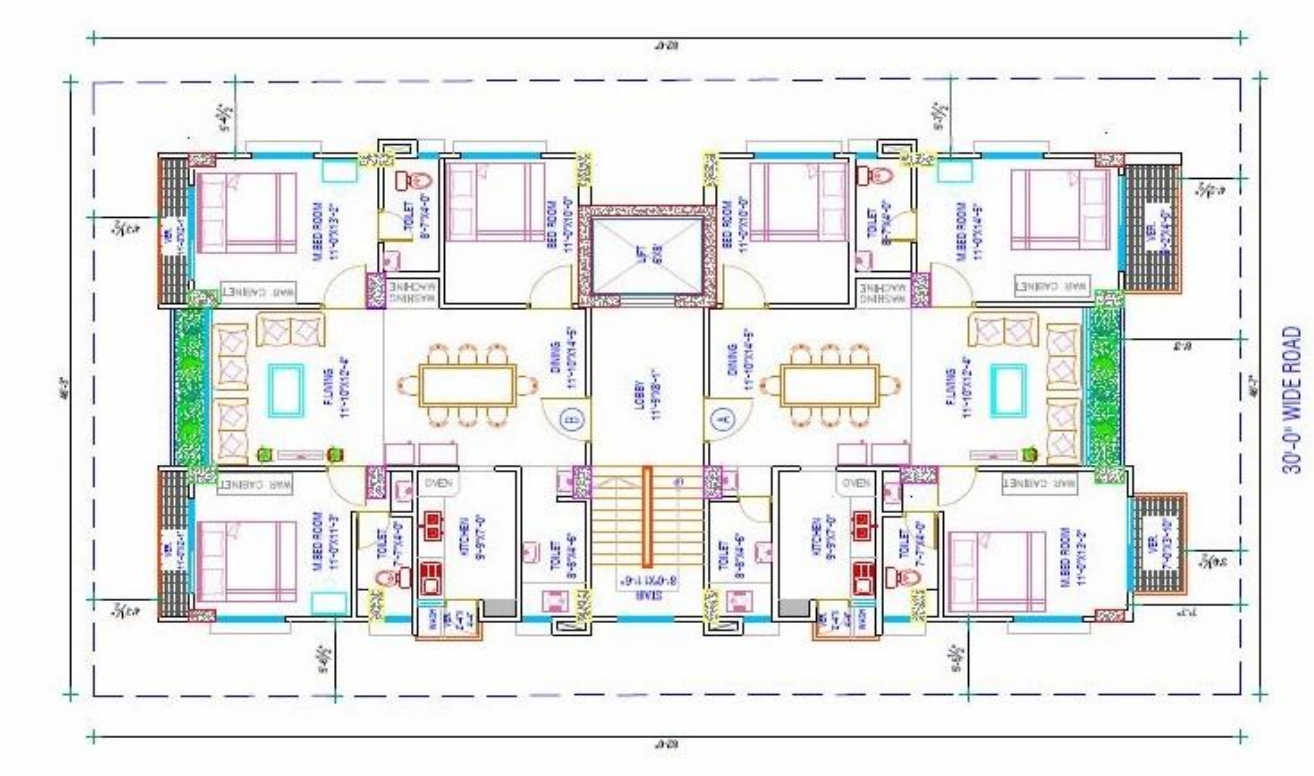


Figure 3.2: Shear wall in the lift core area



Figure 3.3: Shear wall in the lift core, staircase and other corner

3.3 Design Consideration

To analyze the structure, we have followed the BNBC code. According to the BNBC code we consider the design parameter such as live load consideration, load combination, zone co-efficient etc.

3.3.1 Live Load

Unlike dead load, live load refers to the transient or moving loads that structures experience due to human occupancy, furniture, vehicles, and other temporary factors. Live loads vary in magnitude and location over time, as the intended use and occupancy of the structure influences them.

Occupancy or use	Uniform kN/ m2	Concentrated KN
Apartments (see Residential)		
Access floor system		
Office use	2.40	9.0
Computer use	4.80	9.0
Armories and drill rooms	7.20	--

BNBC Part VI Chapter 2

Occupancy or use	Uniform kN/ m2	Concentrated KN
Assembly area and theaters		
Fixed seats (fastened to floor)	2.90	--
Lobbies	4.80	--
Movable seats	4.80	--
Platforms (assembly)	4.80	--
Stage floor	7.20	--
Balconies (exterior)	2.40	--
On one-and two-family residence only, and not Exceeding 19.3 m2	4.80	--

Table 3.1: Live load from BNBC

3.3.2 Wind Load

The basic wing speed is different in different areas of the country depending on the exposure category of the building. In this study we have consider four different arears of the country and these are followings

SL No.	Loaction	Basic Wind Speed, (m/s)
1	Rajshahi	49.2
2	Dhaka	65.7
3	Chottogram	80
4	Sylhet	61.1

Table 3.2: Basic Wind Speed (m/s)

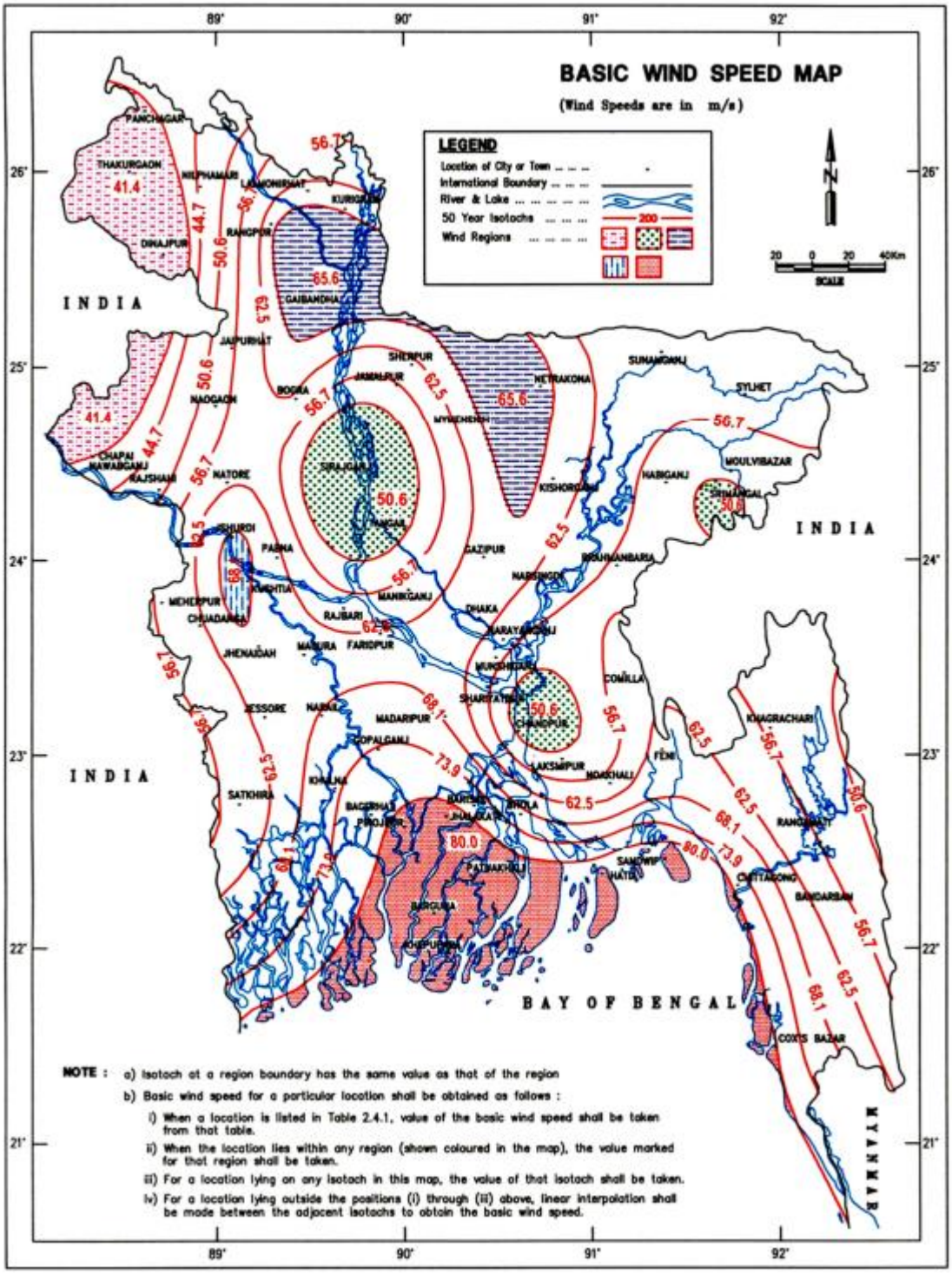


Figure 3.4: Basic Wind Speed Map

3.3.3 Earthquake Load

The purpose of earthquake resistant design provisions in this Code is to provide guidelines for the design and construction of new structures subject to earthquake ground motions in order to minimize the risk to life for all structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential structures to function after an earthquake. It is not economically feasible to design and construct buildings without any damage for a major earthquake event. The intent is therefore to allow inelastic deformation and structural damage at preferred locations in the structure without endangering structural integrity and to prevent structural collapse during a major earthquake.

3.3.3.1 Seismic Zone, Z

Seismic zones are classified depending on the ground crust, tectonic plate beneath the earth crust. BNBC 2020 has classified the four types of seismic zones in the Bangladesh. Previously we have shown the zone map in the study.

Seismic Zone	Location	Seismic Intensity	Seismic Zone Coefficient, Z
1	Southwestern part including Barisal, Khulna, Jessore, Rajshahi	Low	0.12
2	Lower Central and Northwestern part including Noakhali, Dhaka, Pabna, Dinajpur, as well as Southwestern corner including Sundarbans	Moderate	0.20
3	Upper Central and Northwestern fort including Brahmanbaria, Sirajganj, Rangpur	Severe	0.28
4	Northeastern part including Sylhet Mymensingh, Kurigram	Very Severe	0.36

Table 3.3: Seismic Zone Coefficient (Ref. BNBC)

In our study we consider the four different locations which is situated on the four seismic zone in the country for the better result of the study. The locations and the zones are following:

SL No.	Location	Seismic Zone Coefficient, Z
1	Rajshahi	0.12
2	Dhaka	0.20
3	Chottogram	0.28
4	Sylhet	0.36

Table 3.4: Zone Coefficient

3.3.3.2 Structural Important Factor, I

This is the coefficient that accounts the importance of structure for post-earthquake activities. The earthquake lateral force is multiplied by some factor called structure importance co - efficient and are designed for a higher level of force so that the possibility of these structure being undamaged during an earthquake remains higher. But in BNBC 2015 (draft), importance co - efficient is denoted by I for all cases. In BNBC 2015, importance co - efficient is described for four different cases.

Occupancy Category	**Importance factor I**
I, II	1.00
III	1.25
IV	1.50

Table 3.5: Importance Factor, I (Ref. BNBC)

3.3.3.3 Response Modification Factor, R

Response modification factor is one of the seismic design parameters to consider nonlinear performance of building structures during strong earthquake. Relying on this, many seismic design codes led to reduce loads. In other words, response modification factor is the ratio of strength required to maintain the structural elasticity. In fact, the response modification factor (R) reflects the capability of a structure to dissipate energy through inelastic behavior. Systems undergoing inelastic response during severe earthquake incidents. In BNBC 1993, it is known as response modification coefficient. It is the factor by which the actual base shear force that would develop if the structure behaved truly elastic during earth quake is reduced to obtain design base shear. Response modification factor values for different structural systems described the Following

Frame Systems	Response Reduction Factors, R
Special Steel Concentrically braced frames	6
Special reinforced concrete shear wall	6.5
Ordinary reinforced masonry shear wall	3
Ordinary reinforced concrete shear wall	5.5

Table 3.6: Response Reduction Factors (Ref. BNBC)

3.3.3.4 Base Shear, V

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. Calculations of base shear (V) depend on soil conditions at the site and proximity to potential sources of seismic activity (such as geological faults). Probability of significant seismic ground motion and the level of ductility and over strength associated with various structural configurations and the total weight of the structure are also responsible for base shear variations. Base shear also depends on the fundamental (natural) period of vibration of the structure when subjected to dynamic loading Base share,

$$V = Sa \times W$$

$$\text{Here, } Sa = 2\ ZICs / 3R$$

Sa = Spectrum acceleration

Z = Seismic zonal coefficient

I = Structural importance factor

Cs = Normalized response spectrum acceleration

R = Response modification factor

3.3.4 Load Combination

Provisions of this Section shall apply to all construction materials permitting their use in proportioning structural members by allowable stress/strength design method. When this method is used in designing structural members, all loads listed herein shall be considered to act in the following combinations. The combination that produces the most unfavorable effect shall be used in design.

Basic Load combination:

1. 1.4(D + F)
2. 1.2(D + F + T) + 1.6(L + H) + 0.5(Lr or R)
3. 1.2D + 1.6(Lr or R) + (L or 0.8W)
4. 1.2D + 1.6W + L + 0.5(Lr or R)
5. 1.2D + 1.0E + 1.0L
6. 0.9D + 1.6W + 1.6H
7. 0.9D + 1.0E + 1.6H

3.3.5 Drift

Drift is defined as the lateral displacement. Storey drift is the drift of one level of a multistory building relative to the level below. Inter story drift is the difference between the roof and floor displacements of any given story as the building sways during the earthquake, normalized by the story height. Lateral deflection is the predicted movement of a structure under lateral loads and story drift is defined as the difference in lateral deflection between two adjacent stories during an earthquake or large lateral forces. The design story drift of each storey shall not exceed the allowable story drift as obtained from table for any story

Structure	Occupancy Category		
	I and II	III	IV
Structure, other than masonry shear wall structures, 4 stories or less with interior walls, partitions, ceilings and exterior wall systems that have been designed to Accommodate the story drifts.	0.025 hsx	0.020 hsx	0.015 hsx
Masonry Cantilever shear wall structures Other masonry shear wall structure All other structures	0.010hsx 0.007hsx 0.020hsx	0.010hsx 0.007hsx 0.015hsx	0.010hsx 0.007hsx 0.010hsx

Table 3.7: Allowable story drift limit

3.3.6 Storey Displacement

Storey Displacement is the lateral displacement of the storey relative to the base. Story displacement is the absolute value of displacement of the storey under action of the lateral forces. The overall sway (horizontal deflection) at the top level of the building or structure due to wind loading shall be limited to $\frac{1}{500}$times of the total height of the building above ground.

3.4 Model

Same size of structural elements is considered for four seismic zones in Bangladesh. So, the quantity of materials is varying for same structure in different seismic zones in Bangladesh. It is discussed in chapter four. The models are run in three types structure i.e. without shear wall, shear wall at the lift core area and the shear wall at the outer area in the four specific location Chattogram, Dhaka, Sylhet and Rajshahi.

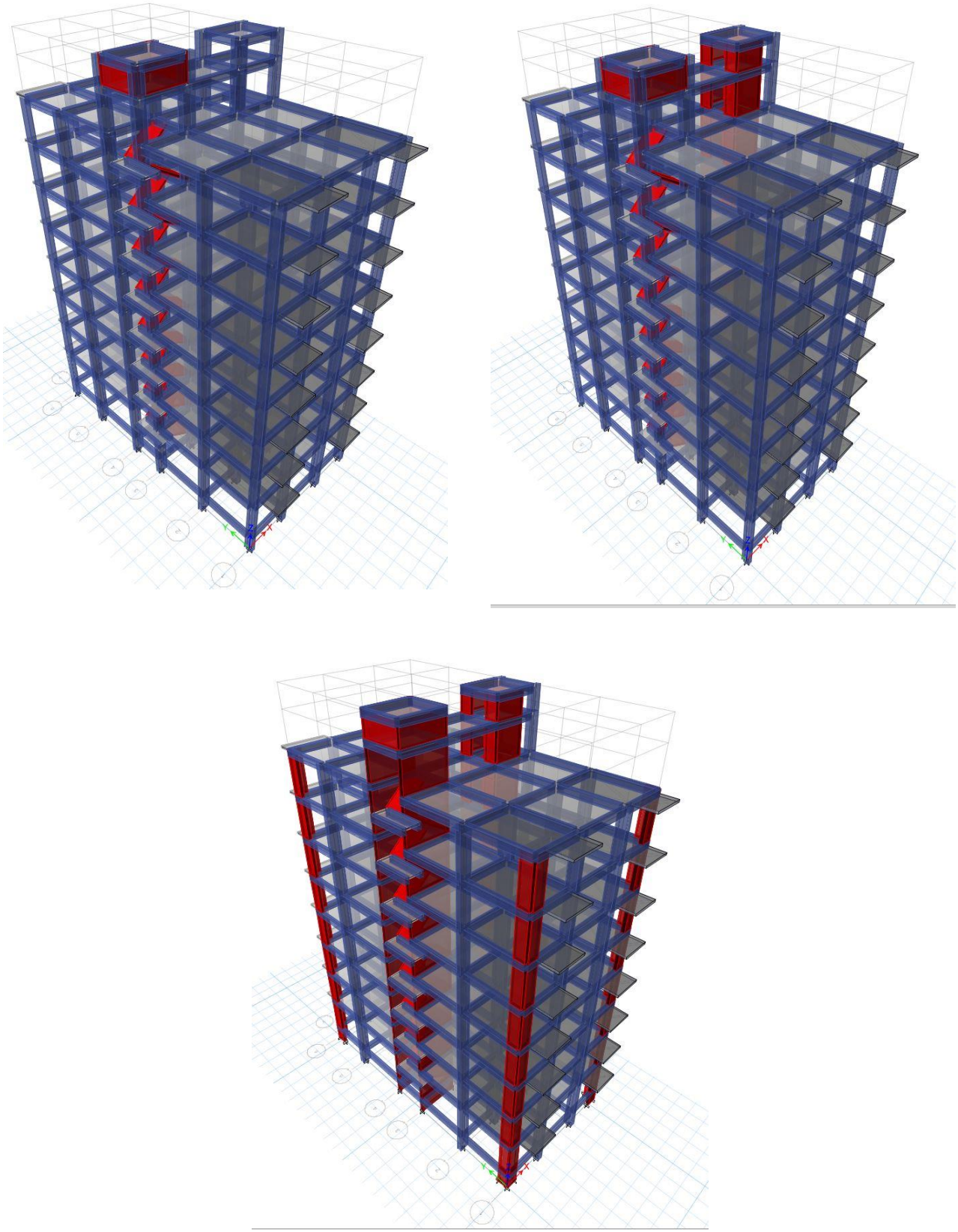
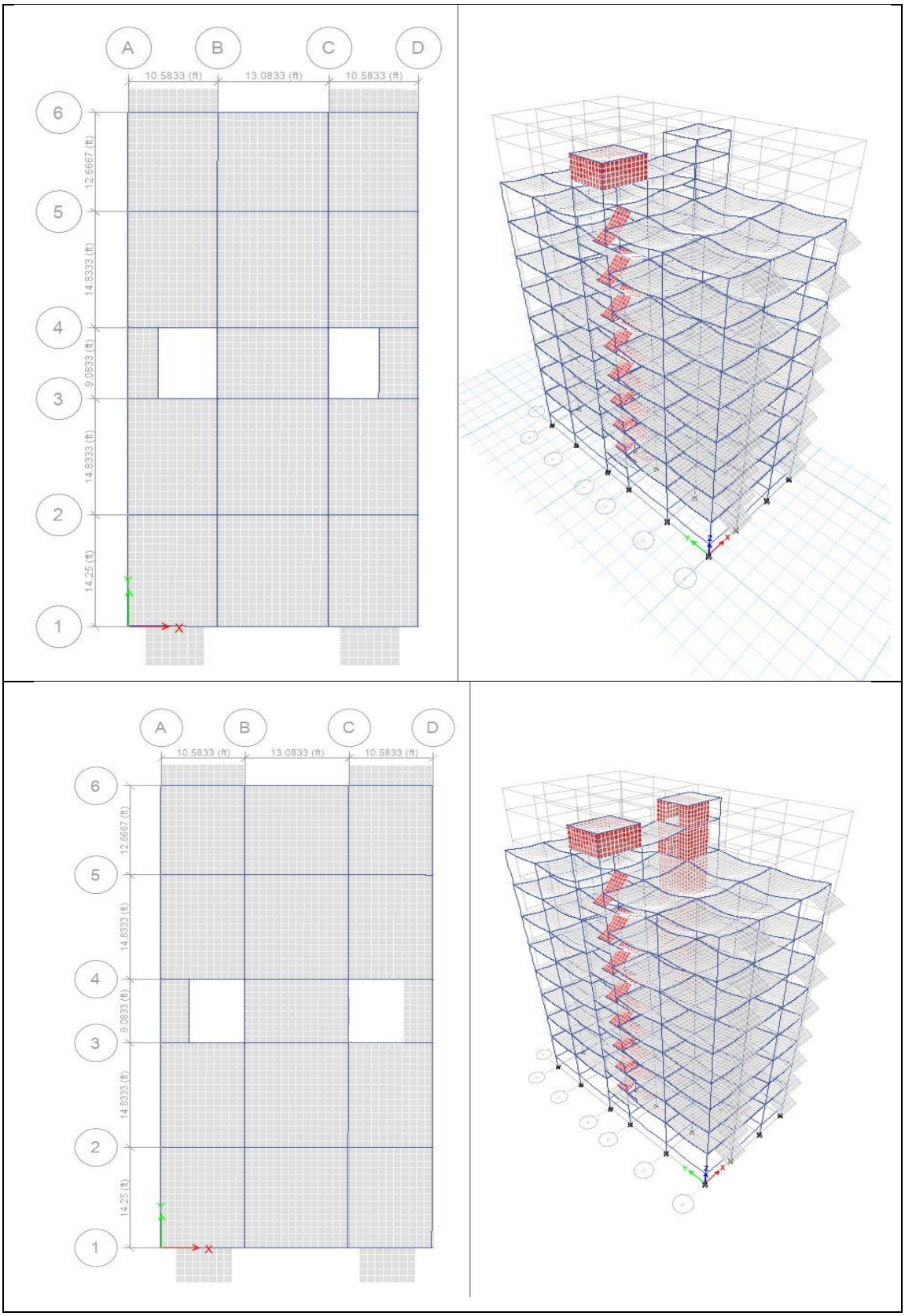


Figure 3.5: Etabs Models with and without shear wall


A
B
C
D
10.5833 (ft)
13.0833 (ft)
10.5833 (ft)
6
5
4
3
2
1
12.6667 (ft)
14.8333 (ft)
9.0833 (ft)
14.8333 (ft)
14.25 (ft)
Y
X
A
B
C
D
10.5833 (ft)
13.0833 (ft)
10.5833 (ft)
6
5
4
3
2
1
12.6667 (ft)
14.6333 (ft)
9.0833 (ft)
14.8333 (ft)
14.25 (ft)
Y
X

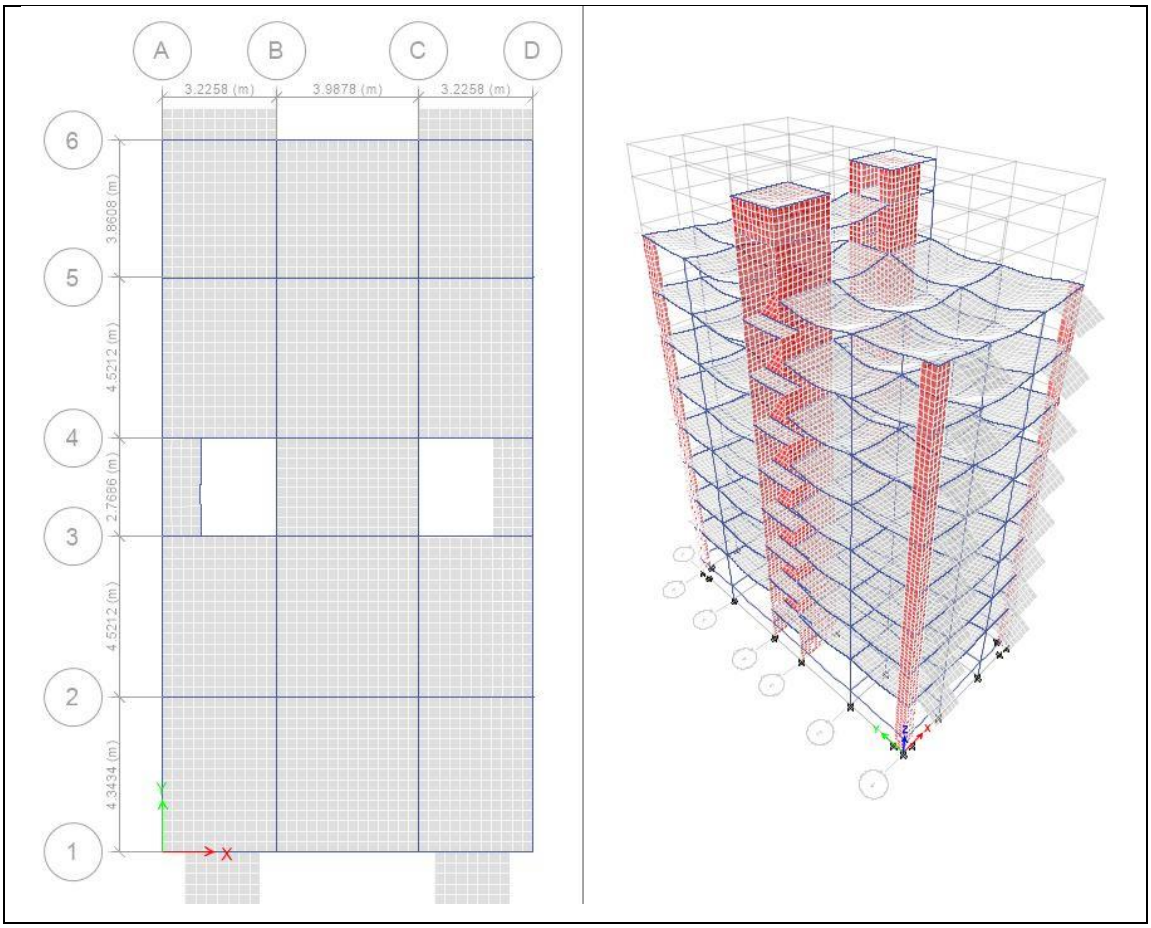


Figure 3.6: Analysis of the structure with and without shear wall

CHAPTER -IV

TEST RESULTS AND ANALYSIS

4.1 Introduction

Analysis and design has been carried out for ten story building heights of buildings (100 feet) is selected for this comparative study different for four seismic zones in Bangladesh. At first comparisons are carried out on analysis results such as story displacement, story drift and base shear in four seismic zones in Bangladesh. Comparisons also carried out on design results of those structures. The variation of the design parameters are observed of the structures and compared the results among the four seismic zones.

4.2 Result Analysis

The structure (100 feet height) is analyzed as an intermediate moment resisting frames (dual system). Loads are considered as per BNBC, 2020 which has been already discussed in chapter three. Results have compared on storey displacement, storey drift, base share, required reinforcements for four seismic zones in Bangladesh.

4.2.1 Storey Displacements

Story displacement for lateral loads at X and Y directions are shown in Figure 4.1 for four seismic zones. For the shear wall in the lift core area the max displacement are in zone four i.e. 68.40 and the displacement in other zones are 36.48, 38, and 38 for the zones 1, 2 and 3 respectively in Y-directions.

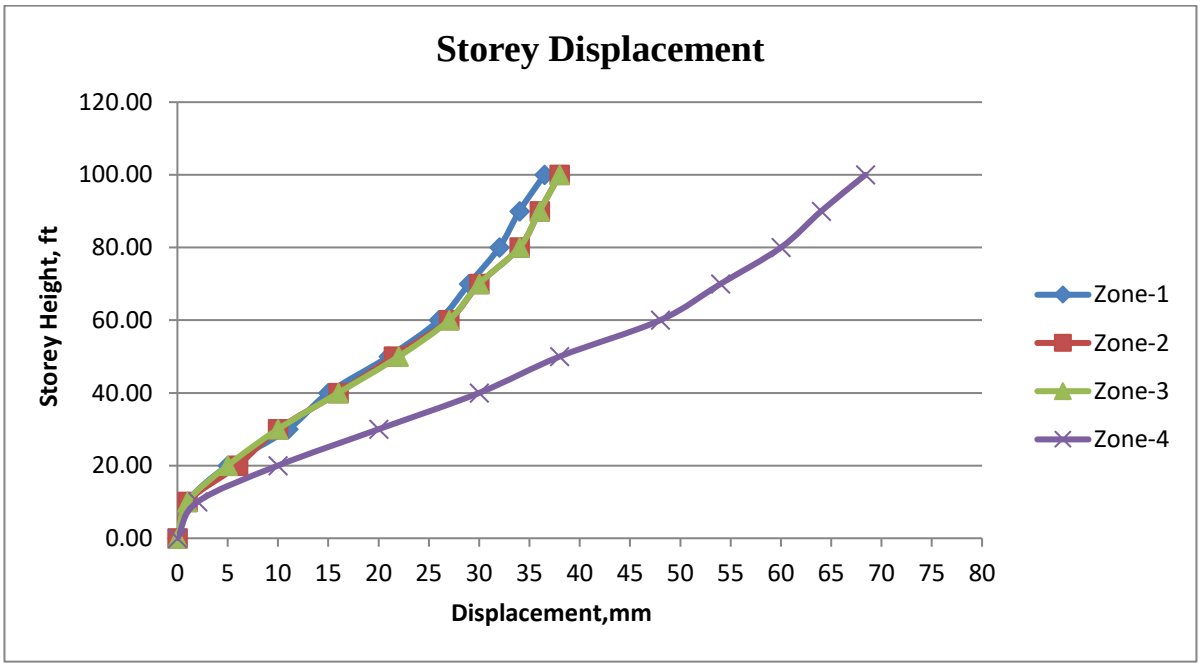


Figure 4.1: Storey Displacement in four zones without shear wall

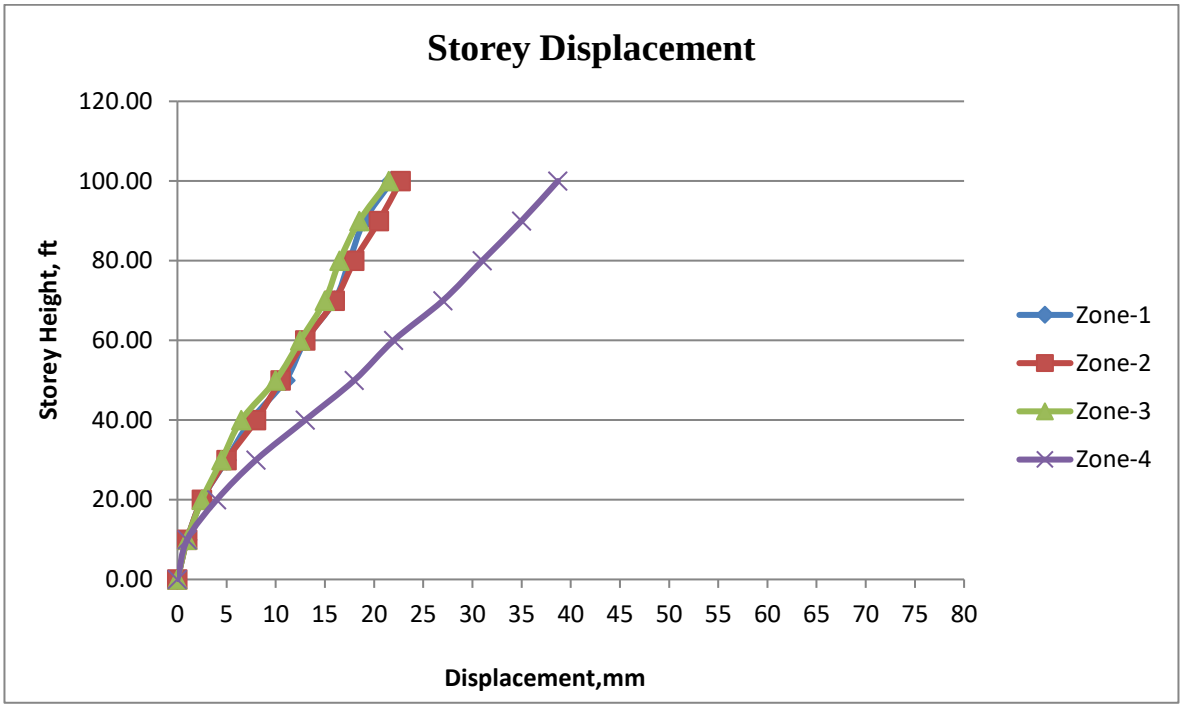


Figure 4.2: Storey Displacement in four zones with shear wall in lift core

For the shear wall in the lift core area the max displacement are in zone four i.e. 38.70 and the displacement in other zones are 21.8, 22.7, and 21.50 for the zones 1, 2 and 3 respectively shown in figure 4.2 in Y-Direction.

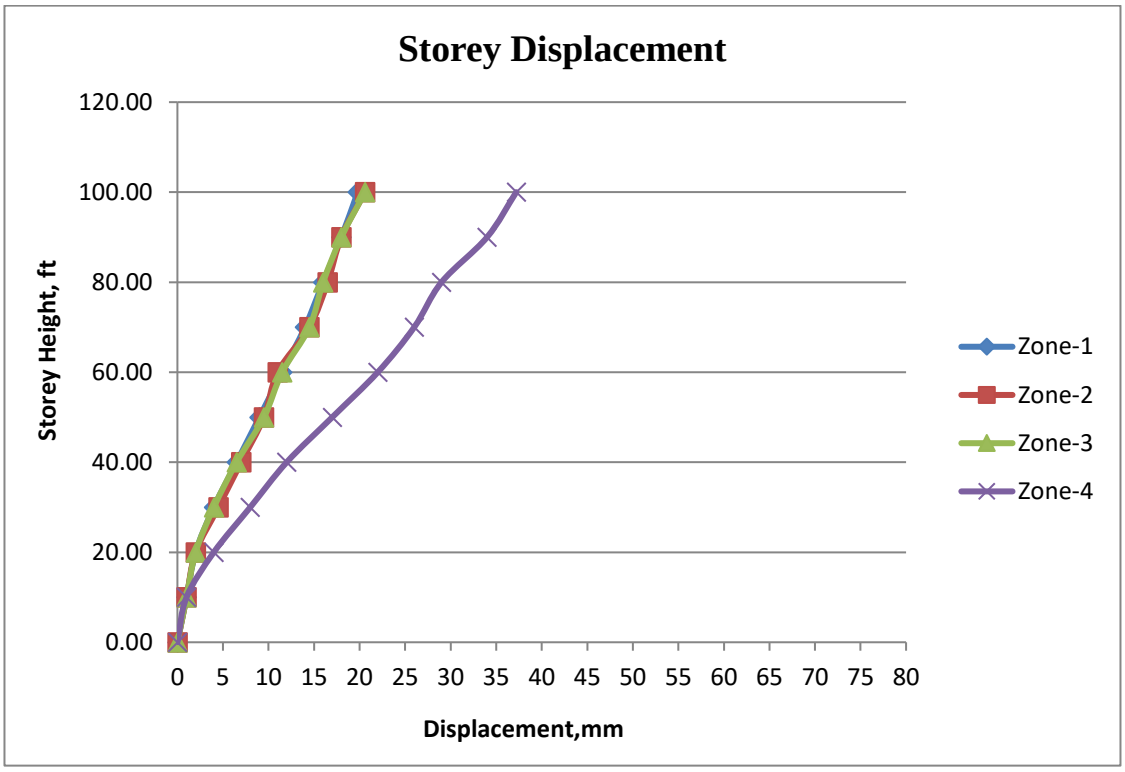


Figure 4.3: Storey Displacement in four zones with shear wall in outer corner

For the shear wall in the outer area the max displacement are in zone four i.e. 37.20 and the displacement in other zones are 19.8, 20.6, and 20.6 for the zones 1, 2 and 3 respectively shown in figure 4.3 in Y-Direction.

4.2.2 Storey Drift

Story drift is caused for lateral loads (earthquake and wind) in structure. Here we only consider the X-direction earthquake load because this is the maximum effects in all considerations. In the Figure 4.4 shows the max drift 0.0038 in zone four. Zone 1, 2 and 3 the results are 0.0018, 0.00188 and 0.00188 respectively.

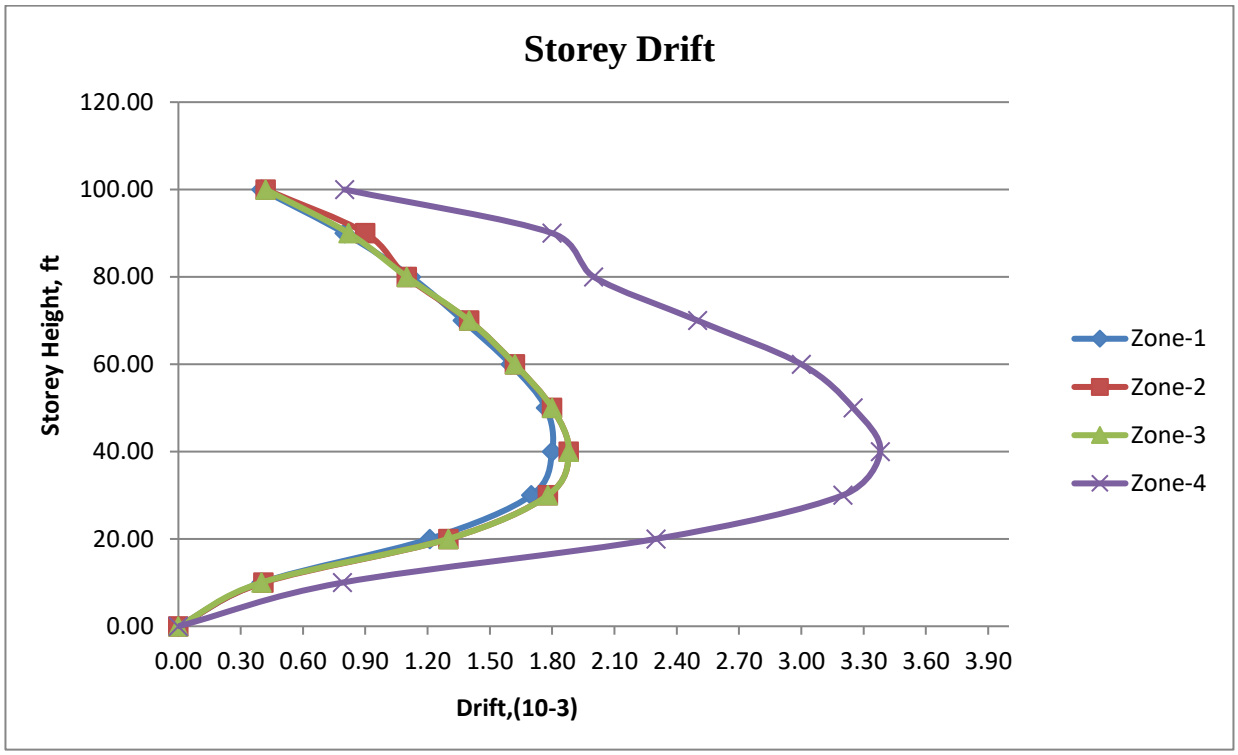


Figure 4.4: Storey Drift in four zones without shear wall

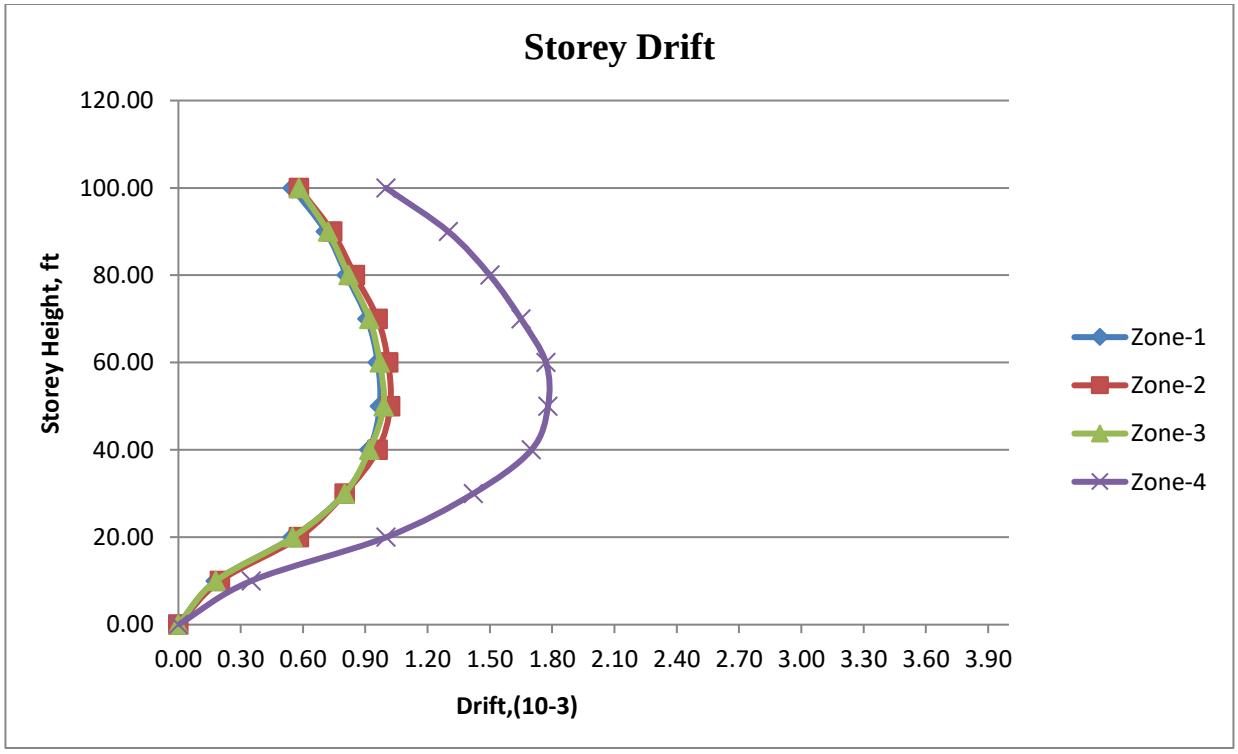


Figure 4.5: Storey Drift in four zones with shear wall in lift core

In the Figure 4.5 shows the max drift 0.00178 in zone four. Zone 1, 2 and 3 the results are 0.0097, 0.00102 and 0.0099 respectively.

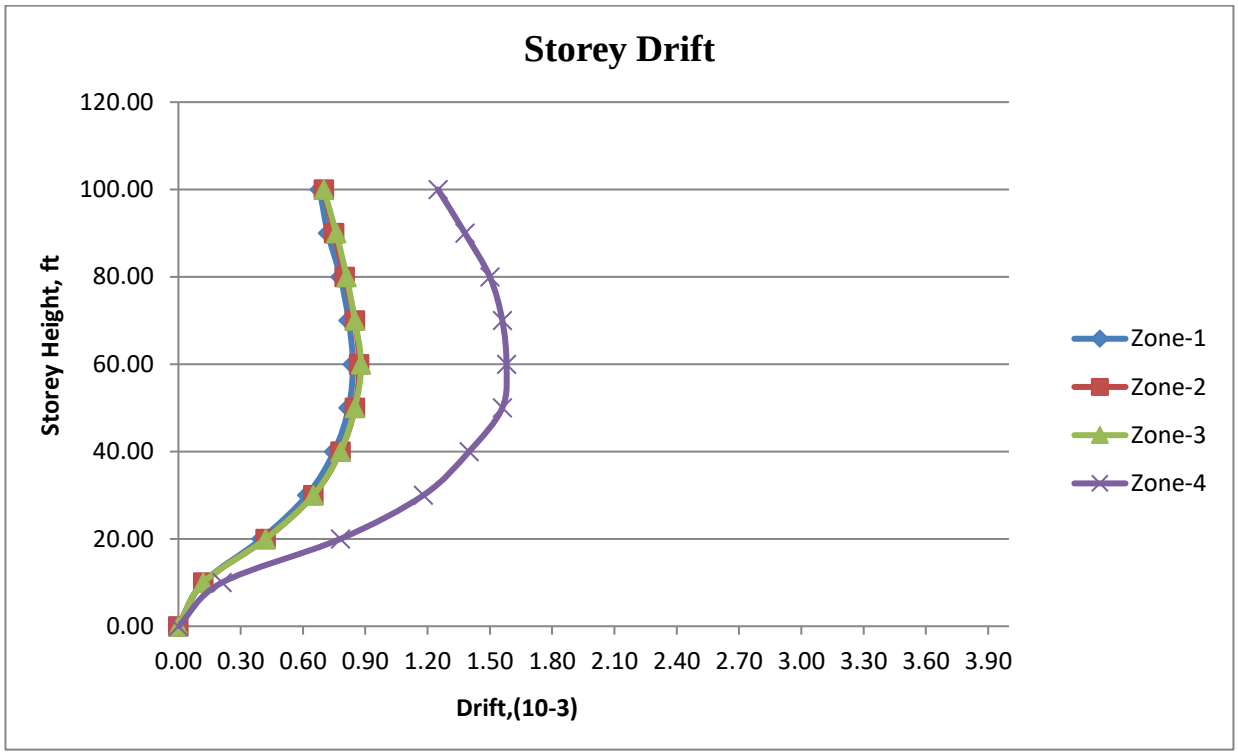


Figure 4.6: Storey Drift in four zones with shear wall in outer corner

In the Figure 4.6 shows the max drift 0.00158 in zone four. Zone 1, 2 and 3 the results are 0.0084, 0.0087 and 0.0088 respectively.

4.2.3 Stiffness

Stiffness for the structure with no shear wall has shown in figure 4.7. In this figure, the maximum stiffness is 1566712 Kn/m for all zones. The minimum stiffness is also same for the zones.

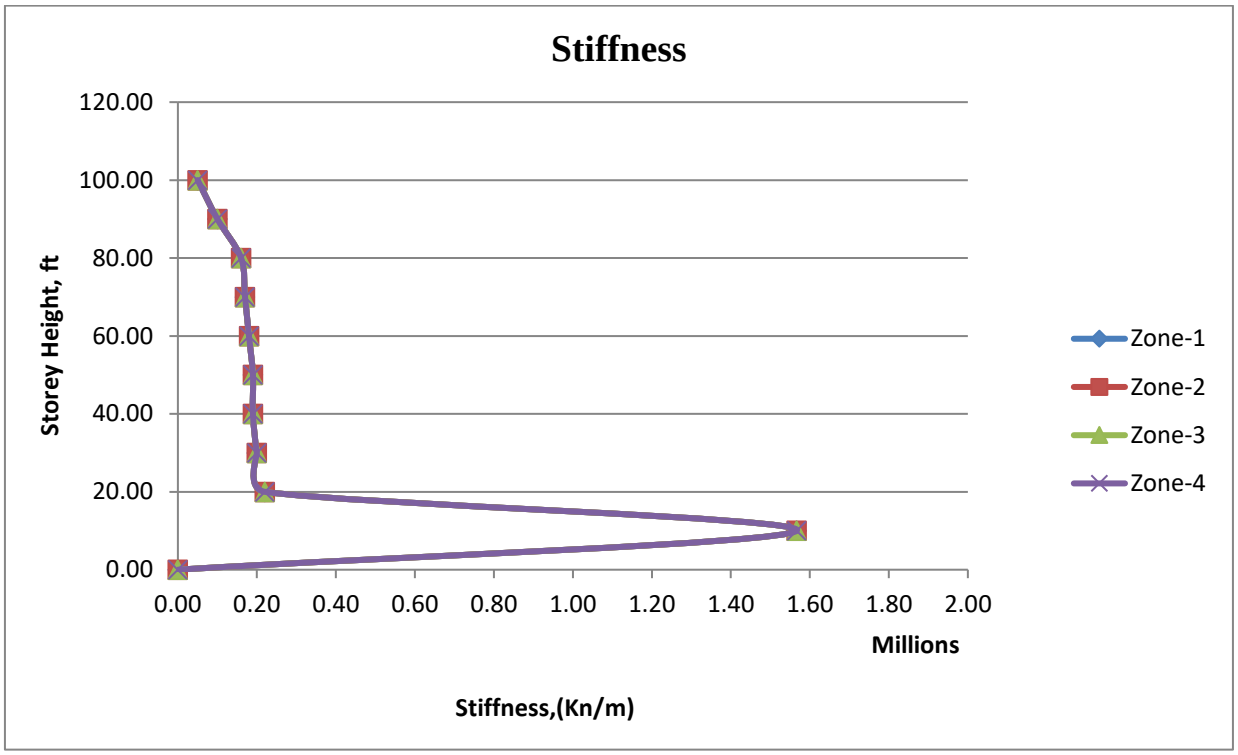


Figure 4.7: Stiffness in four zones without shear wall

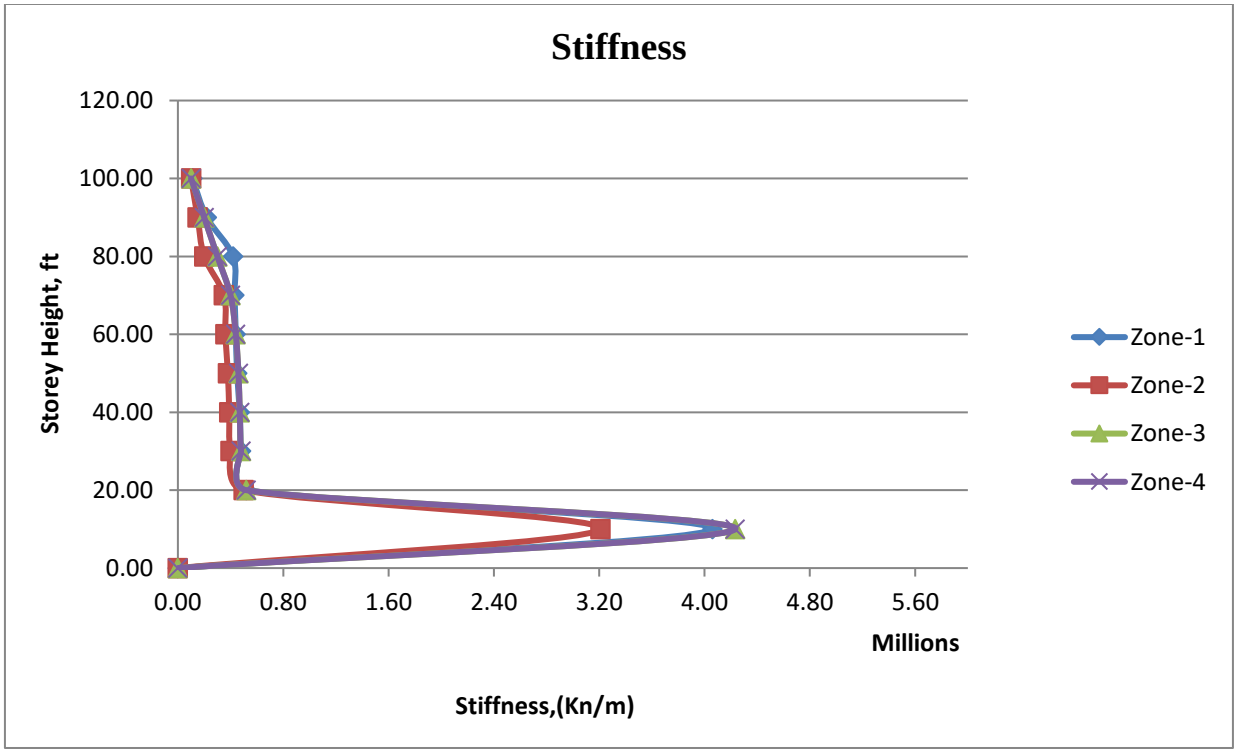


Figure 4.8: Stiffness in four zones shear wall in lift core

Stiffness for the structure with no shear wall has shown in figure 4.8. In this figure, the maximum stiffness is 4233426 Kn/m in the zone 3 and 4. The minimum stiffness is also same for the zones.

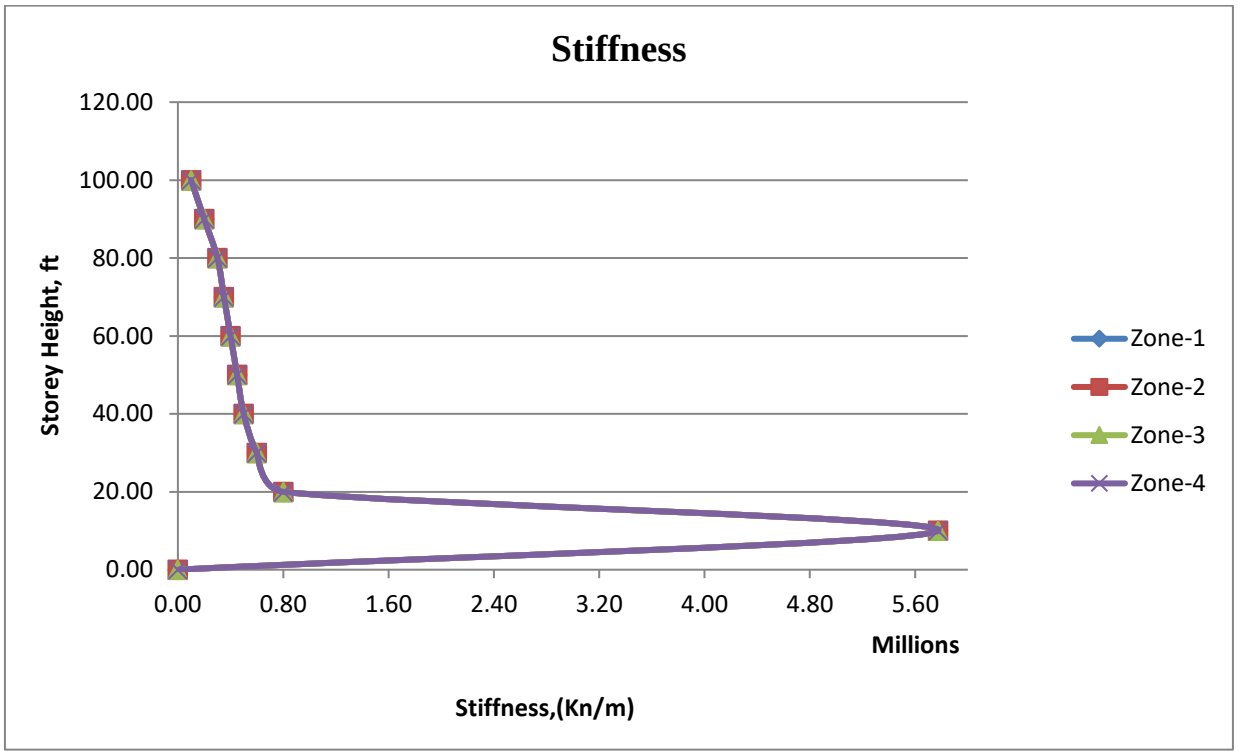


Figure 4.9: Stiffness in four zones shear wall in outer corner

Stiffness for the structure with no shear wall has shown in figure 4.9. In this figure, the maximum stiffness is 5774616 Kn/m for all zones. The minimum stiffness is also same for the zones.

4.2.4 Base Shear

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. Calculations of base shear (V) depend on soil conditions at the site. Proximity to potential sources of seismic activity (such as geological faults) Figure 4.10 shows the total base shear of this selected structure are 2.8, 2.91, 4.08, and 5.25 percentage of weight, respectively in four seismic zones.

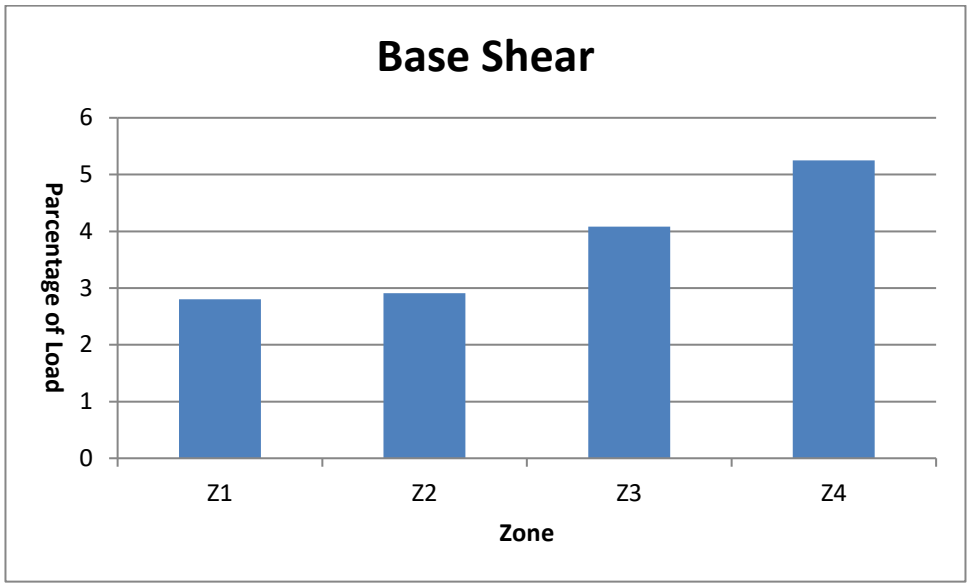


Figure 4.10: Base Shear in four zones without shear wall

CHAPTER-V

CONCLUSION AND RECOMMENDATION

5.1 General

Bangladesh is located in a tectonically active region close to the plate boundaries of the Indian plate and the Eurasian plate. The effect of earthquake is more severe in an underdeveloped and a densely populated country like Bangladesh than any other developed countries. According to building codes, earthquake resistant structures are intended to withstand the largest earthquake of a certain probability that is likely to occur at their location. This means the loss of life should be minimized by preventing collapse of the buildings for rare earthquakes while the loss of the functionality should be limited for more frequent ones. Accurate historical information on earthquakes is very important in evaluating the seismicity of Bangladesh in close coincidences with the geotectonic elements. The aim of this study is to give an idea of the structural engineer about the costing of same structure in four seismic zones in Bangladesh. It may insist to contract proper seismic resistance building in four seismic zones of Bangladesh. To fulfill the aim of the study two different heights (150 feet and 80 feet) of building are considered as individual buildings are analyzed and designed separately, for four seismic loads as per BNBC- 2020. All these buildings are analysis considered intermediate moment resisting frame (dual system) with constant wind load. Selected structures are designed by using ETABS - 2016 considering seismic loads as per BNBC 2015 in four seismic zones of Bangladesh. Seismic detailing of various structural elements are done based on BNBC 2015.Finally, structural drawing are prepared of these building for cost estimation. The following conclusions could be done as per height of the structures.

5.2 Conclusion

After an extensive and systematical study, the following conclusions could be derived as per height of the structure.

1. The Storey Displacements are varying with the location of shear wall and it is controlled with the use of shear wall rather than without shear wall.
2. Drift are also same as the storey displacement of the structure i.e. drift is minimum while using shear wall rather than without shear wall.
3. Stiffness in increased by using shear wall rather than without shear wall.
4. Base shear are increasing with the zone change, but remain same with shear wall and without shear wall.

5.3 Recommendation

This research can be done many following ways:

1. The study can also be effective while considering the beam and column effects of four zones.
2. The variations of reinforcement in beam and column with zones can also be study.
3. The cost evaluation of the structure can also be study with zone coefficient.

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