Retrofit RMG Factory by Steel Bracing According to BNBC 2020

A Project and Thesis submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Civil Engineering

by

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JANUARY- 2021

Certification

This is to certify that this project and thesis entitled "Retrofit RMG Factory by Steel Bracing According to BNBC 2020" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the department of Civil engineering under the faculty of engineering of daffodil international university in partial fulfillment of the requirements for the degree of bachelor of science in civil engineering. The presentation of the work was held on 3rd April 2021.

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Wx	Horizontal wind force at X direction
Wy	Horizontal wind force at Y direction
Ex	Horizontal Earthquake force at X direction
Ey	Horizontal Earthquake force at Y direction
RSx	Response spectrum force at X direction
RSy	Response spectrum force at Y direction

ACKNOWLEDGEMENT

First of all, we give thanks to Allah or God. Then we would like to take this opportunity to express our appreciation and gratitude to our project and thesis supervisor **MD. MEHEDI HASSAN BHUIYAN, Lecturer** of **Department of Civil Engineering** for being dedicated to supporting, motivating, and guiding us through this project. This project can't be done without his useful advice and helps. Also thank you very much for allowing us to choose this project.

We also want to convey our thankfulness to **Dr. Miah M. Hussainuzzaman, Associate Professor and Head** of the **Department of Civil Engineering** for his help, support, and constant encouragement.

Apart from that, we would like to thank Md. Saju Ali for sharing Laptop; information and helping us in making this project a success. Also thanks for lending us some tools and equipment.

To our beloved family, we want to give them our deepest love and gratitude for being very supportive and also for their inspiration and encouragement during our studies at this University.

ABSTRACT

Keywords -

CHAPTER 1

INTRODUCTION

1.1 INTRODUCATION

Earthquake is a hazardous scenario of developing country. The techno-data graduates are observed that the plate data that India and Eurasia plate have is observed from the long-term location of the space. The country's seismologists believe that developing country like Bangladesh will face a serious crisis, so the cities of Dhaka-Sylhet-Chittagong are considered to be in the first stage of danger. Although the structure of the building is not sufficient against earthquakes, a structure is constructed well the building so that it performs comparatively well during earthquakes. Seismic retrofitting is an appropriate technique to stable the structure against earthquake. Disclosure of design codes as a practice of professionals for the need to adopt efficient optimal retrofitting techniques for specific structures.

1.2 State of the Problem

Earthquake could be catastrophic for Bangladesh. The last major earthquake in Bangladesh was in the year 1918 which was known as Simental Earthquake. The magnitude of the earthquake was 7.6 Bangladesh. Earthquakes cannot be prevented, but it is possible to reduce the damage a bit. The retrofitting technique does not prevent the severity of the earthquake or destructive activity by increasing the mass and stiffness of the building, but it is possible to save the people from the risk of death by constructing the building with some caution.

Fig. 1. 1 Inverted x Steel bracing

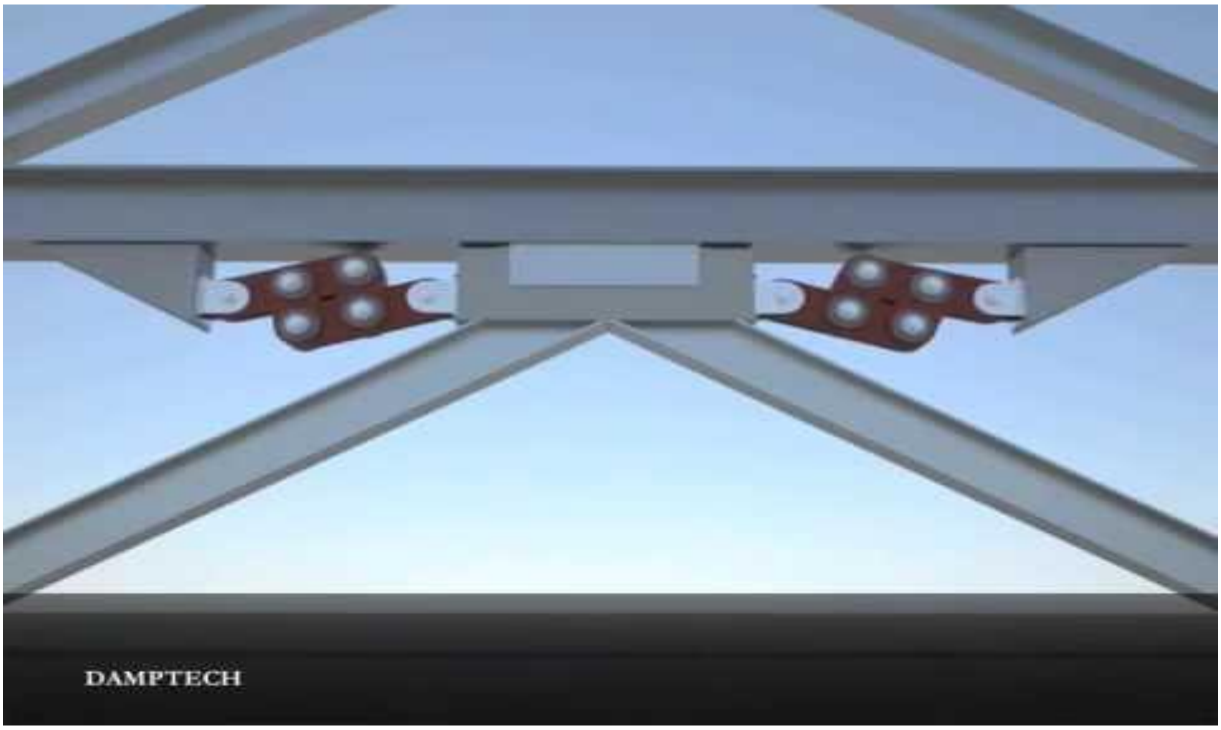


Fig. 1. 2 Inverted V Steel bracing

1.3 Objectives

This study focuses on these topics specifically which is showing below

To access the structure behavior of existing RMG Factory building with different sizes Steel "X" bracing system arrangement in different seismic zone.

1.4 Scopes

Increasing the efficiency of the building is the work of retrofitting so one of the strategies to increase this strength is steel bracing system. It comes in different types like X-type, V-type, Inverted V-type and ZX-type steel bracing systems etc. In this study only done by steel X-type bracing.

1.5 Organization of Thesis

Chapter 1: In the first chapter we discussed some of the basics about earthquakes and retrofitting and what to do.

Chapter 2: The second chapter discusses what has been done in the past and what kind of work is used in the building.

Chapter 3: Discusses what we have analyzed and how we have done.

Chapter 4: The fourth chapter summarizes what we have analyzed and those images from it using different types of bracing after analysis are shown here. And finally the results are discussed.

Chapter 5: The results of what we analyzed and the displacement ratios we got are discussed. And the future of it can be further worked out.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

When structures fail, earthquakes wreak havoc on lives, money and a great deal. An important topic or field for studying earthquake mitigation at present is the complete construction of earthquakes in a collection of seismic engineering mitigation. It is one of the most important earthquake-prone areas in the history of the country and is extremely important for tall or expensive structures. Before the introduction of 19 modern seismic codes for developed countries such as China, Japan, Turkey, China, etc. among other countries in the world in 1960, earthquake protection was formulated without increasing the strength of many structures.

2.2 Seismic Retrofitting

Seismic retrofitting is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. The retrofit techniques are also applicable for other natural hazards such as tropical cyclones, tornadoes, and severe winds from thunder storms. Seismic retrofitting is needed when earthquake damaged buildings or to reduce the hazards and losses from an earthquake to the buildings with no exposure to severe earthquakes. In the past seismic retrofitting was applied primarily to public safety and economic activity of buildings and political constraints. Performance targets in different locations gradually became recognized as follows depending on the performance of seismic engineering.

- Protecting human life is a key factor in public safety to ensure that it does not crash into pedestrians and that they can safely exit the building in the event of an accident or unforeseen situation.

- While the structure is in a safe exit, it is effective and may need to be considered (not for replacement) before it is considered safe for the profession.

- Structure unaffected this level of retrofit is preferred for historic structures of high cultural significance.

While building evaluations indicate that the building should be rebuilt, the building's energy potential will not increase and future earthquake recovery will not be sufficient.

2.3 Classification of Retrofitting Techniques

Seismic strengthening or retrofitting is generally carried out in the following ways (i) Structure level or global retrofit methods (ii) Member level or local retrofit methods.

Common seismic retrofitting techniques can be summarized as illustrated.

Table 2. 1 Retrofitting Techniques

Global techniques	Local techniques
Adding Shear Wall.	Jacketing of Beams
Adding Bracing.	Jacketing of Columns
Adding Infill Wall	Jacketing of Beam
Adding Wing Wall	Strengthening of Individual Footing

2.3.1 Jacketing

Concrete jacketing [1] is a method where the longitudinal bars of the concrete layer are closely intertwined. Increases flexural strength in T-jacketing method and anti-rust strength in T-columns. The columns are connected to each other in the abdomen and the pen is cut to gossip with chainless grout.

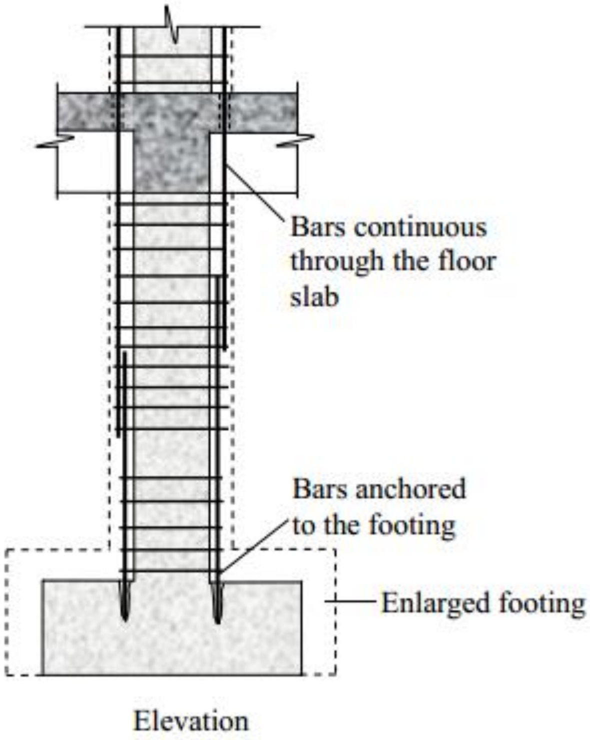


Fig. 2. 1 Concrete jacketing of a column

2.3.2 Shear Wall

Shared walls [2] are introduced in buildings with flat slabs or frames. Buildings do not have conventional frames so the lateral strength and stiffness can be significantly reduced.

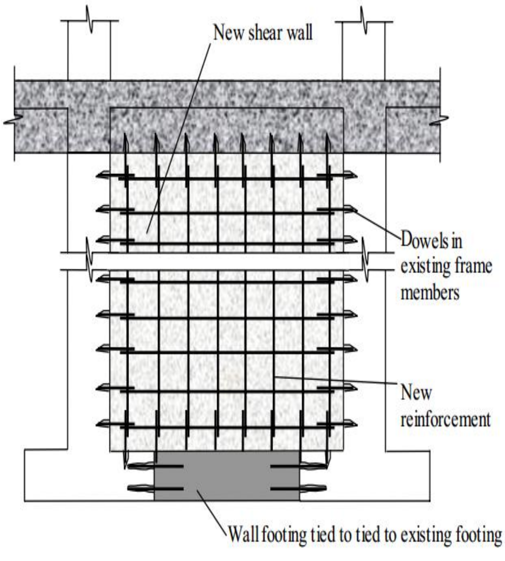


Fig. 2. 2 Addition of shear wall

2.3.3 Infill wall

An executive method for the complete construction of a building is to keep the ground starter in an open position with the infill walls [3] and ground.

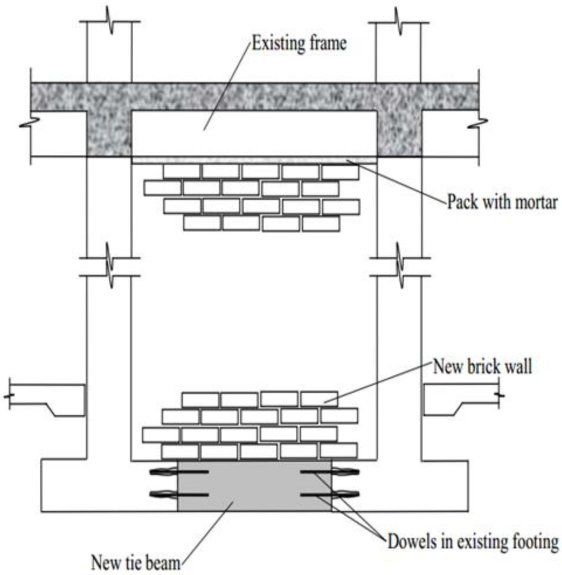


Fig. 2. 3 Addition of masonry infill wall

2.3.4 Mass Reduction

It can be said that a massive reduction for reconstruction by omitting one or a bunch of data Strategic methods can be adopted by Mass Reduction [4].

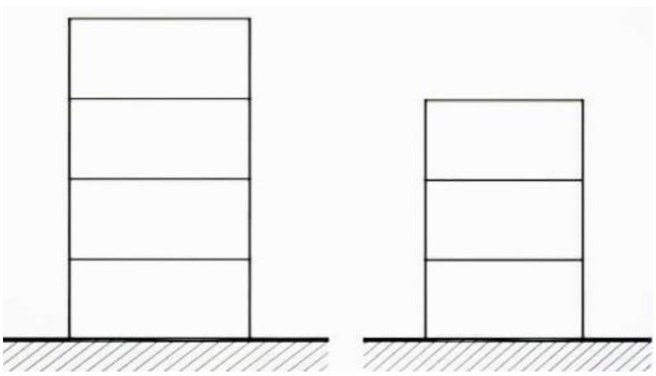


Fig. 2. 4 Mass reductions by removing mass of one story

2.3.5 Dampers

Seismic dampers[5] are used diagonally in the components of structures to play a role in controlling earthquake damage. It basically absorbs the energy of the earthquake and reduces the speed of the building.

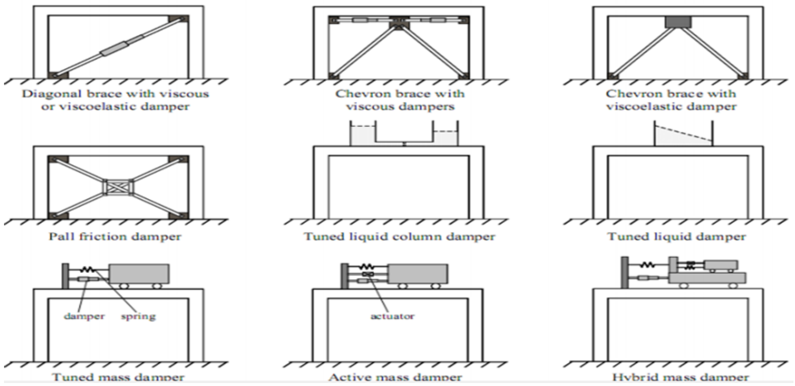


Fig. 2. 5 Different kinds of Dampers

2.3.6 Bracing

Strong concrete bracing[6] can be used to use steel structures. This bracing can be used for lateral energy flexibility energy dissipation or a combination of any one of these in a steel frame. The bracing can be added at the exterior frames with the least disruption of the building use. For an open ground story, the bracing can be placed in appropriate bays to retain the functional use. The connection between the braces and the existing frame is an important consideration.

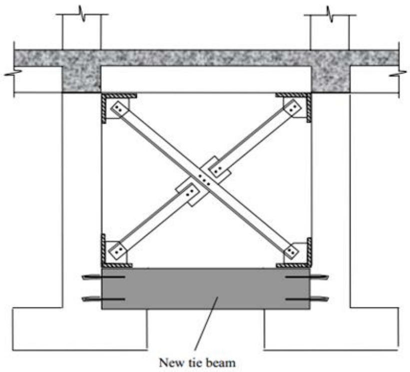


Fig. 2. 6 Addition of steel braces

2.4 Previous Studies Regarding Retrofitting with Bracing Arrangements

In reinforcement concrete building shear walls are usually used to resist lateral earthquake load, though most of the time steel bracing is used in steel structure. In Reinforcement Concrete (RC) Frame steel bracing is successfully used which published a number of reports in last two decades. For improving earthquake resistance capacity in steel bracing Reinforced concrete (RC) building retrofitting measure started on earthquake damaged buildings or existing building.

To know more details about bracing pattern system Kamal M studied in 2017. In six storied building was analyzing with bracing pattern system by Kamal, which was unsafe for Earthquake load but safe for gravity load. There are different types of bracing X bracing, V bracing converse and there was consider two types of bracing preparation was considering for his study and comparison was made about the bracing type and Pattern. In his research paper it is clearly seen that more economical steel is X type of hollow steel like in medium Earthquake zone steel section is decreased with ensuring the structural stability.

Moan Amino A. et al[7].by non-linear dynamic analysis with different cubic braking. Among the studies they conducted were a set of multi-story steel buildings associated with three types of X, V and Chevron braking, two adjacent coastal locations and two perpendiculars to the building and considered the behavior of two incoherent bay earthquakes.

Buildings were designed based on code. Buildings were compared to Standard Performance Level PL. Results show that in all cases, bracing arrangement in non-adjacent bays leads to lower stiffness but higher strength than in adjacent bays, and that for Immediate Occupancy PL, plastic zones appear mostly in lower stories, while for Life Safety and Collapse Prevention PLs they appear just in few lower stories.

Chaddar SK A et Al[8]. has studied inverted and V view method on RC building. Here the author uses five methods of braking between Robi and Ultano V to compare their flexibility and rigidity. Seismic coefficient method (linear static analysis) has been conducted to evaluate the effect of different arrangements of bracing member in the building frame and influence of the steel cross-section.

2.5 Research Methodology

First I modeled a building and then we gave it a run. After the run, our building failed. The name of that method is bracing method. We installed different types of bracing there. After installing our thickness 16 size bracing, we saw that our building has passed. We installed it according to BNBC 2020 rules.

2.6 Summary

This study found that different authors referred to different assessment methods. Some research methods were used. Most outsiders have used X-bracing or no specific braking in the building and researched building frames for bracing. All the research work was carried out mainly to increase the high capacity by braking system. The whole steel building has realized the effectiveness of different bracing patterns so the building reconstruction project requires different bracing patterns of the building.

The result of this research will provide an understanding of the behavior of retrofitted system with steel bracing in reinforced concrete (RC) building which is not observable in simple linear analysis.

CHAPTER 3

ANALYSIS AND SIMULATION

3.1 Introduction

In the previous chapter we learned about earthquakes resistant in different side of the world with different technologies and retrofitting. In our country, buildings are constructed without complying with building codes and due to improved materials and inefficiency, earthquake recovery methods are adopted. This chapter discusses concept input data through ETABS as well as seismic deficit assessment for gravity loads for gravity loads and full construction of earthquakes through bracing methods.

3.2 Criteria for Selection of Buildings

There are many factory buildings in Dhaka city. There are some buildings in these buildings which have been designed according to the right design and Some of the buildings that were able to withstand the earthquake were built according to the building design policy, but due to the inexperience of the experts, some of the buildings were found to have construction defects.

3.3 Input Data for Analysis

Following input data has been used for analyzing the buildings. ETABS also calculates some necessary data which are relevant to the input data by using default formula.

3.3.1 Material specifications

The material property of this factory building tabulated in table 3.1

Table 3. 1 Factory Building of Material property

Material Name	Strength (psi)	Elastic modulus (psi)
concrete	4000	3604996.53
Steel	50000	29000000

3.3.2 Building layout & Cross sectional properties

Our study RMG factory plan view given in Fig. 3.1.

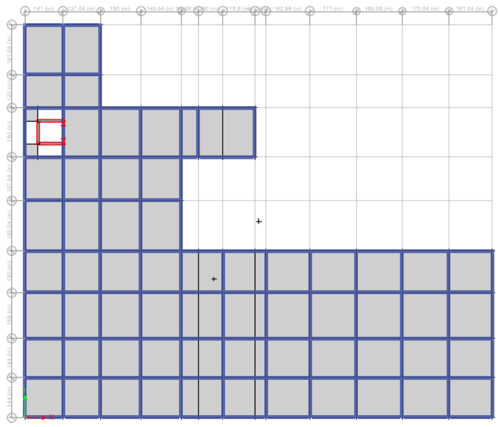
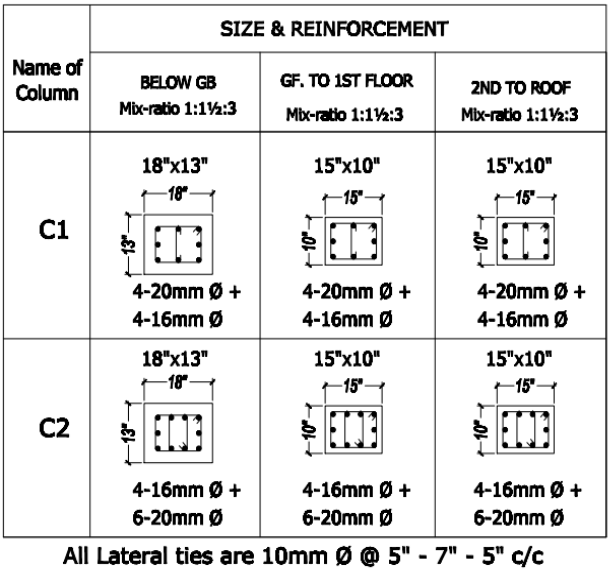


Fig. 3. 1 Plan view of RMG Factory

Column Minimum size of column provision was eliminated by ACI code (ACI 318-02 R10.8) if the structure is not special moment resisting frame. Cross sectional properties of column depend on combined flexure and axial loads. Minimum column size 100 square inch and least lateral dimension 10 inch is considered for analysis.

Beam As per ACI code (ACI 318-02 9.5.2.1) minimum depth of beam stipulated unless computation of deflection indicates a lesser thickness. To calculate the uniform depth of a beam having more than one span with various span lengths, larger span is considered. Besides the general practice of non-engineered buildings in Dhaka city has been taken in to account. Hence, the depth of beam 15 inch and width 10 inch is considered in this study.



Name of Column	SIZE & REINFORCEMENT		
	BELOW GB Mix-ratio 1:1½:3	GF. TO 1ST FLOOR Mix-ratio 1:1½:3	2ND TO ROOF Mix-ratio 1:1½:3
C1	18"x13" 4-20mm Ø + 4-16mm Ø	15"x10" 4-20mm Ø + 4-16mm Ø	15"x10" 4-20mm Ø + 4-16mm Ø
C2	18"x13" 4-16mm Ø + 6-20mm Ø	15"x10" 4-16mm Ø + 6-20mm Ø	15"x10" 4-16mm Ø + 6-20mm Ø

All Lateral ties are 10mm Ø @ 5" - 7" - 5" c/c

Fig. 3. 2 column schedule of factory building

3.3.3 Concrete protection for reinforcement

In ordinary concrete, the building up steel is ensured by the normally high alkalinity (pH over 12) of the solid around the support. A defensive oxide layer is conformed to the building up steel that assists with forestalling the supporting steel from consuming within the sight of high alkalinity.

3.4.4 Gravity loads

Gravity loads used as per BNBC 2020

Table 3.2 Gravity loads

Load Name	Load Value
Floor finish	1.12 KN/m2
Floor finish at roof	0.72 KN/m2
Partition wall	1.12 KN/m2
Boundary wall	7.3 KN/m
Live	4 KN/m2
Live at roof	1 KN/m2

3.4.5 Seismic loads As per Equivalent Static Load Method

The fundamental strength U is imparted with respect to figured loads, or related internal minutes and forces. Figured weights are the loads shown in the general development standard expanded by appropriate weight factors. The factor allotted to each store is affected by the degree of precision to which the stack sway generally can be resolved and the assortment that might be ordinary in the load during the lifetime of the development. Dead loads, since they are altogether the more unequivocally chose and less factor, are allotted a lower load factor than live loads. Weight factors moreover address variability in the essential examination used to deal with minutes and shears. combinations of Factored Loads.

3.5 Modeling for Seismic Retrofitting with Different Bracing System

In Chapter 2 we have seen that there are many types of retrofitting systems. In this we are using the bracing system. This is because steel materials are obtainable. And it is very easy to implement. Steel material is very easily available and we have a factory in this developing country. The bracing choices we have made are given in Table 4.1. We have applied this bracing in every zone. I have found the displacement ratio. Fig. The locations where I used the brakes. It is given in Fig (4.1-4.6)

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In the past chapters we have learned about methodology, The RMG building already established in savar. But in this chapter we will discuss what we have analysis in FEA package (ETABS). We have worked with four zones here: Zone 1, Zone 2, Zone 3, Zone 4, according to BNBC 2020. In our study four different size of thickness and four different cross sectional x bracing used. Bracing thickness are 13mm, 16mm, 18mm and 25mm which are available in developing country like Bangladesh. The cross sectional sizes are 150x150, 200x200, 250x250, 300x300 (in mm unit). Our analysis result and graphs are discussing in detail in section 4.3.

4.2 Analysis for variant bracing

Here are few Figure and elevation view of the building that we have analyzed with bracing. In This study we usually use X steel bracing.

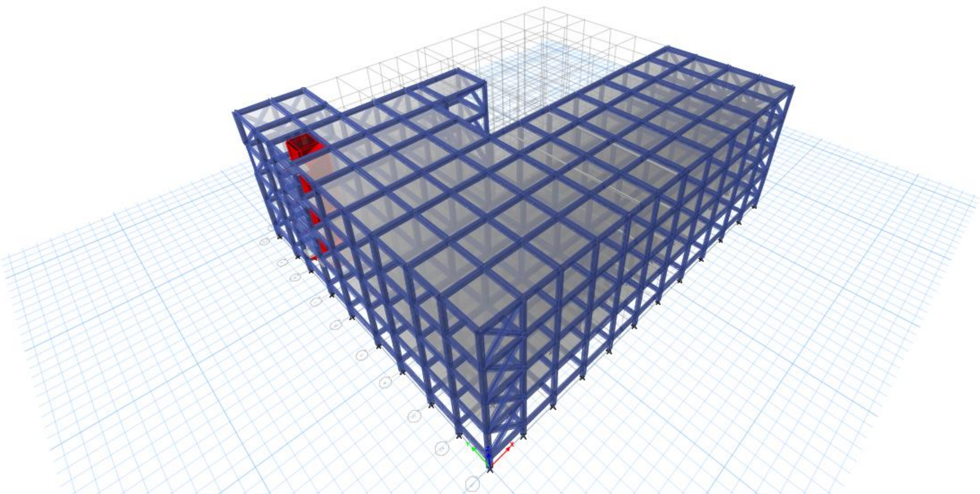


Fig. 4. 1 FE Model of RC building with bracing (RMG Factory)

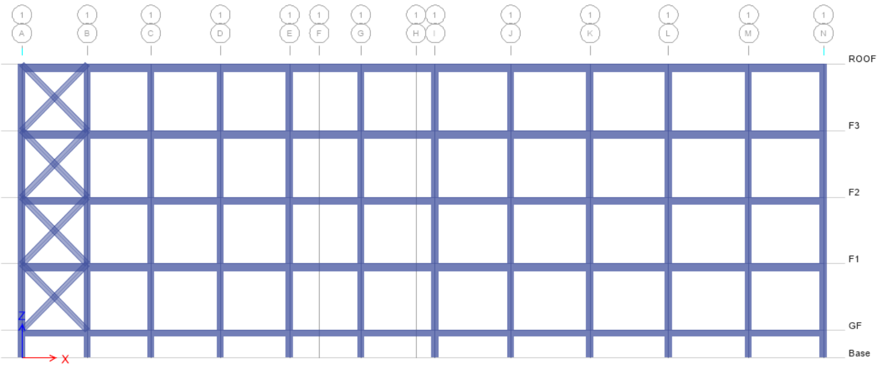


Fig. 4. 2 X directional bracing of FE Model (Elevation-1)

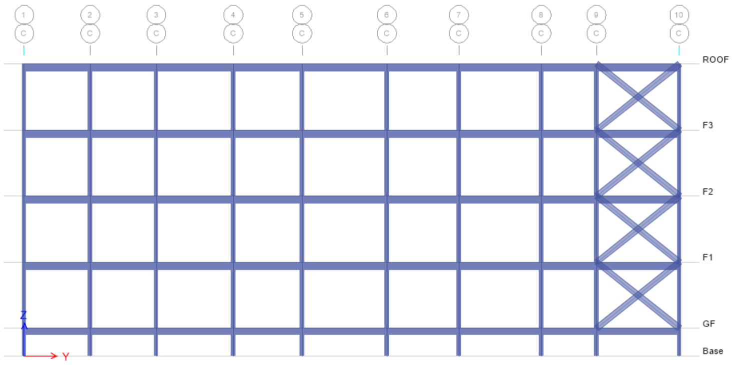


Fig. 4. 3 Y directional bracing of FE Model (Elevation-C)

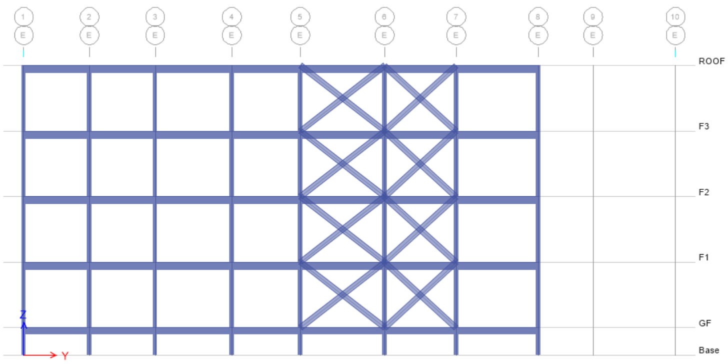


Fig. 4. 4 Y directional bracing of FE Model (Elevation-E)

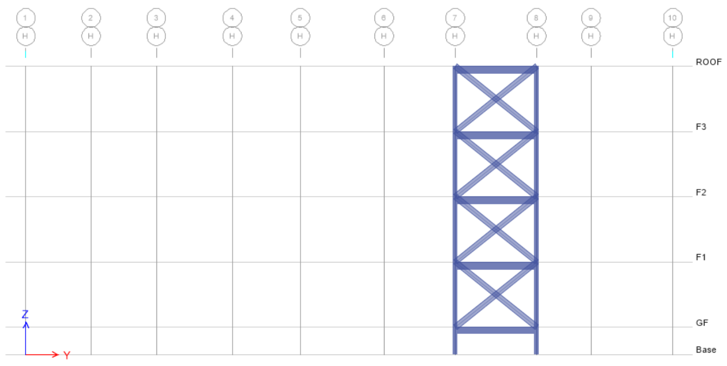


Fig. 4. 5 Y directional bracing of FE Model (Elevation-H)

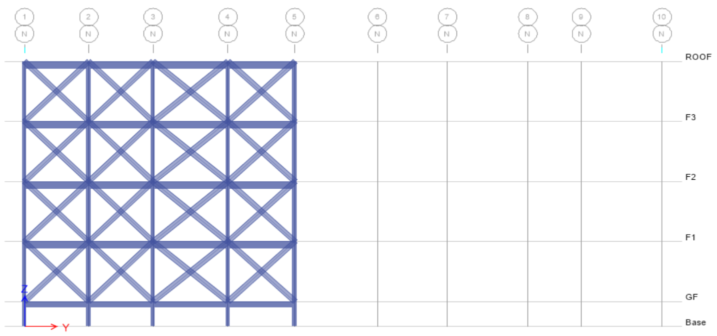


Fig. 4. 6 Y directional bracing of FE Model (Elevation-N)

In our FE Analysis we are used 16 different types steel x bracing, which are shown in Fig 4.2-4.6. The size of bracing are shown in below table.4.1

Table 4. 1 Steel X bracing size

Bracing Designation	Cross Section size(mm × mm)	Thickness (mm)
B150-1	150×150	13
B150-2		16
B150-3		18
B150-4		25
B200-1	200×200	13
B200-2		16
B200-3		18
B200-4		25
B250-1	250×250	13
B250-2		16
B150-3		18
B250-4		25
B300-1	300×3-200	13
B300-2		16
B300-3		18
B300-4		25

4.3 ZONE ANALYSIS

4.3.1 ZONE -1

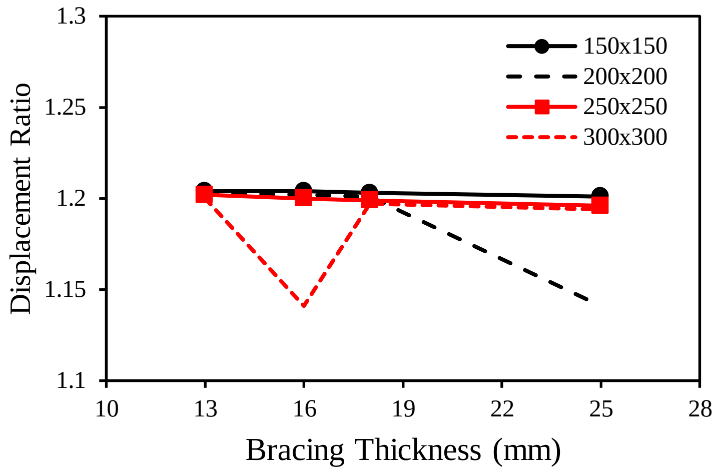


Fig. 4. 7 Displacement Ratio for X direction earthquake force (zone-1)

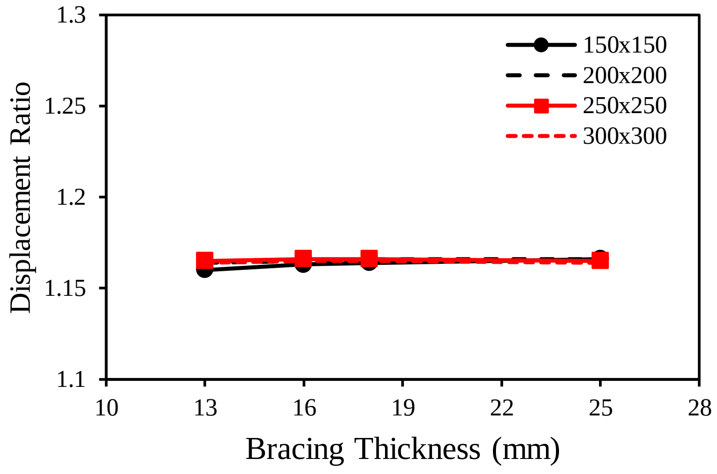


Fig. 4. 8 Displacement Ratio for y direction earthquake force (zone-1)

According to analysis result for without bracing, we were seen that the displacement ratio for the Y direction earthquake force was irregular. To reduced irregularity of RC building we started install steel X bracing (Fig. 4.1-4.6). After applied retrofitting in RC building the displacement ratio less than 1.2, which was good for structure for Y direction earthquake force (BNBC 2020)

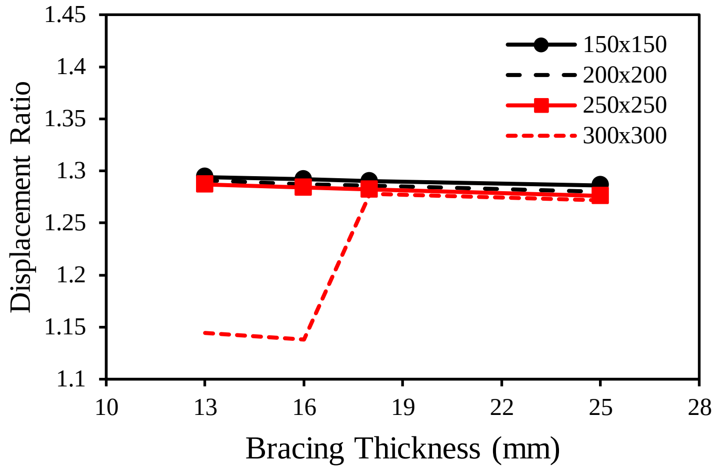


Fig. 4. 9 Displacement Ratio for x direction response spectrum force (zone-1)

There was no bracing in the building, the Displacement Ratio for X direction for the response spectrum towards the earthquake was just Ok. Later, by increasing the thickness of bracing, the value was reduced a lot.

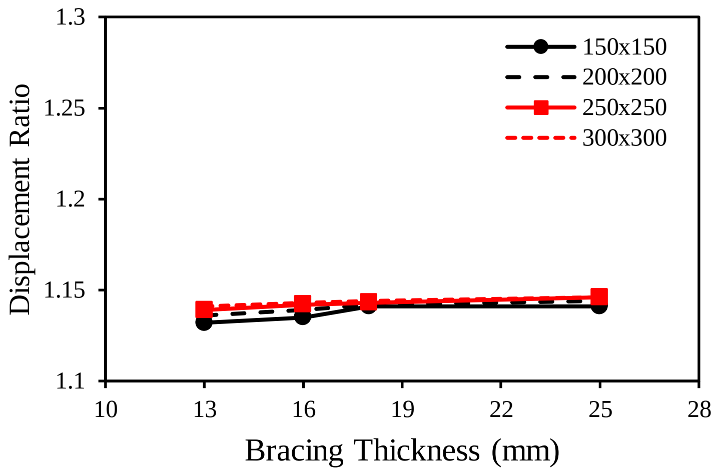


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Fig. 4. 10 Displacement Ratio for y direction response spectrum force (zone-1)

There was no bracing in the building, the Displacement Ratio for Y direction for the response spectrum towards the earthquake was just Ok. Later, by increasing the thickness of bracing, the value was reduced a lot.

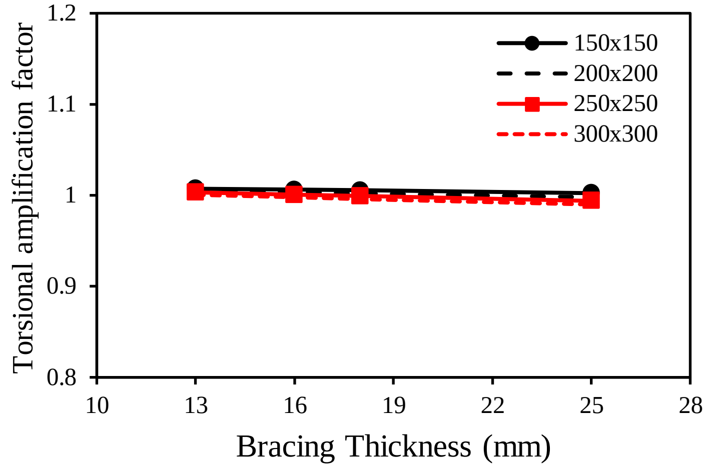

Fig. 4. 11 Torsional amplification factor for x direction earthquake force (zone-1)

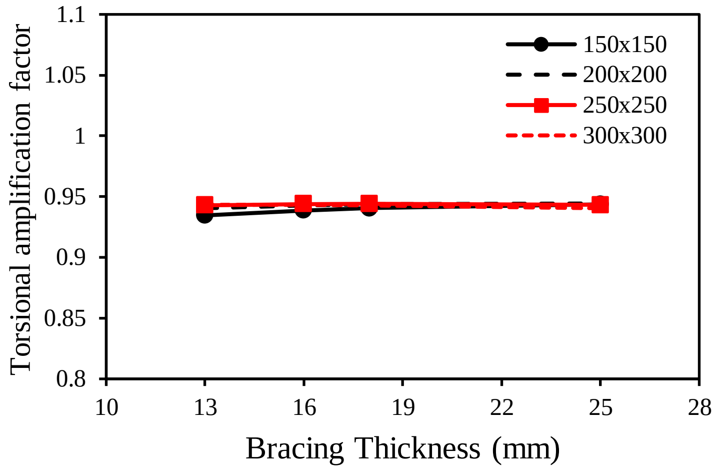

Fig. 4. 12 Torsional amplification factor for y direction earthquake force (zone-1)

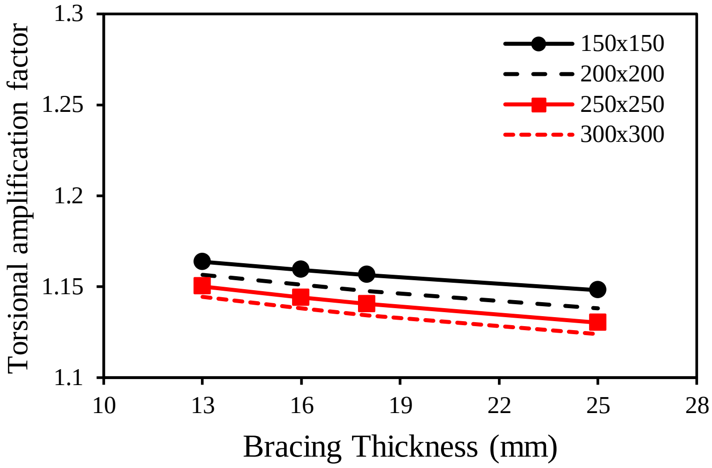

Fig. 4. 13 Torsional amplification factor for x direction response spectrum force (zone-1)

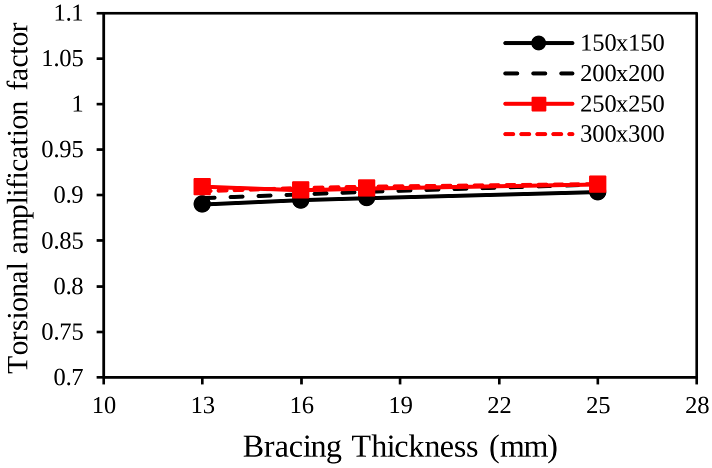

Fig. 4. 14 Torsional amplification factor for y direction response spectrum force (zone-1)

4.3.2 Zone 2

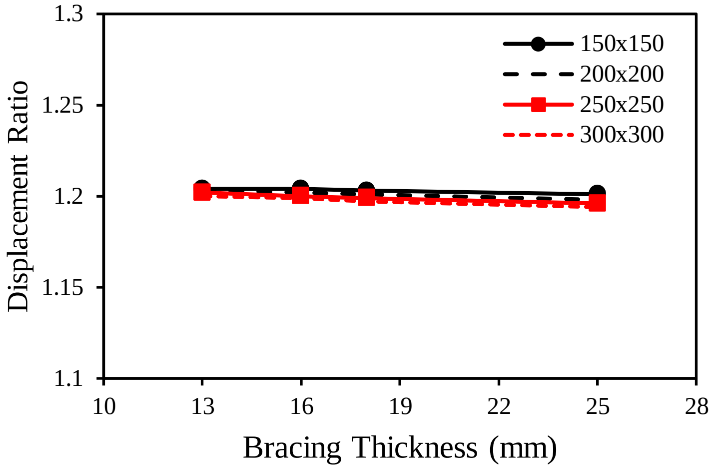

Fig. 4. 15 Displacement Ratio for x direction earthquake force (zone-2)

If we look at the graph for zone 2, the value of displacement ratio was maintained when bracing was not given here. Subsequent low-size bracing resulted in the displacement ratio becoming irregular along the X in the direction of the earthquake, with a value of 1.204. Later, by increasing the bracing size, the value of X is equal to 1.904 in the direction of the earthquake force was ok (BNBC 2020.

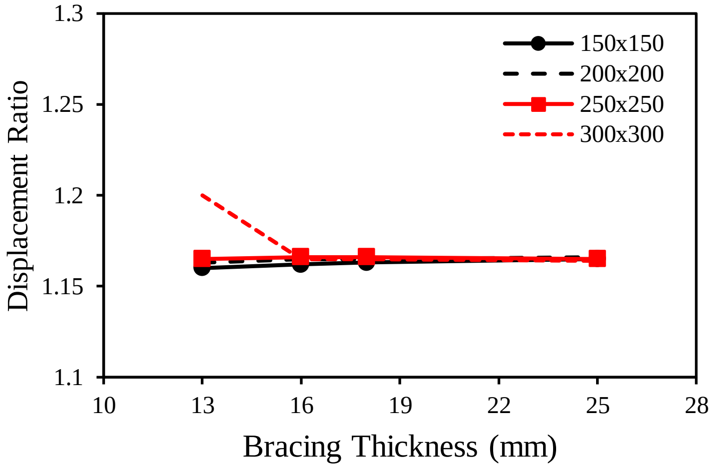

Fig. 4. 16 Displacement Ratio for y direction earthquake force (zone-2)

When we analyzed the results without bracing, we saw that the displacement ratio for Y was extreme towards the earthquake force. Later, using (B-150-1, the value of y was ok in the direction of the earthquake force. (BNBC 2020)

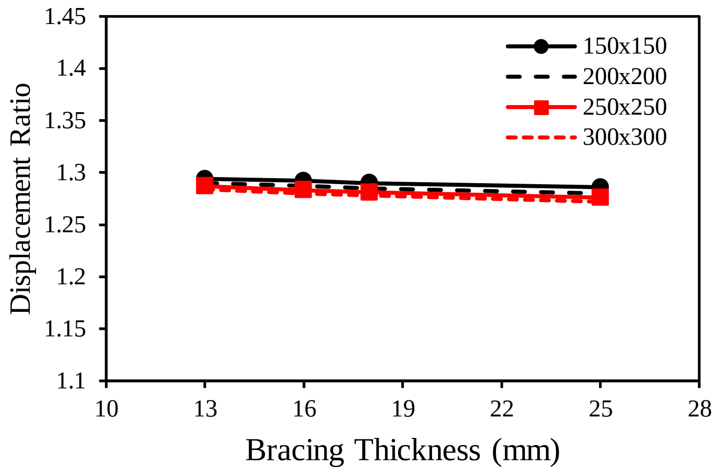

Fig. 4. 17 Displacement Ratio for x direction response spectrum force (zone-2)

The results we got from the analysis were that without bracing there was a ok Displacement Ratio for the earthquake force response spectrum X. But later, after setting the bracing size to 150-1, I noticed that the Displacement Ratio for the earthquake force response spectrum X became irregular with a value of 1.294. Later the B300-1 size also became irregular after the bracing was installed. But the value was less than the previous value of 1.260.

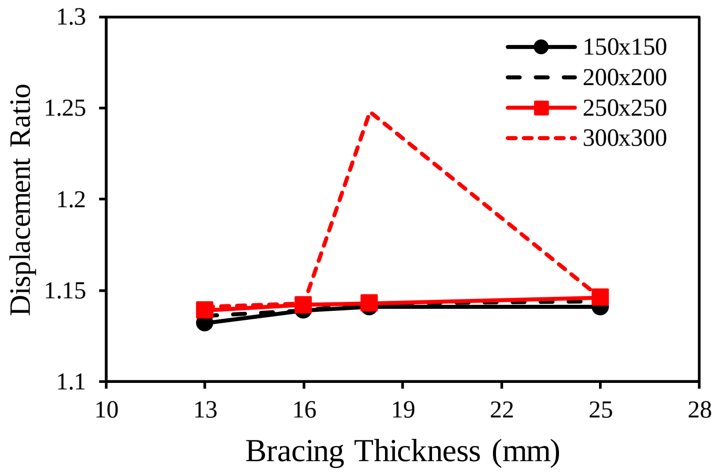

Fig. 4. 18 Displacement Ratio for y direction response spectrum force (zone-2)

The results we got from the analysis were that without bracing there was an extreme Displacement Ratio Y for the earthquake force response spectrum y. But after setting the ba-150-1 bracing size later, I saw that the Displacement Ratio Y for the earthquake force response spectrum Y was ok (BNBC 2020)

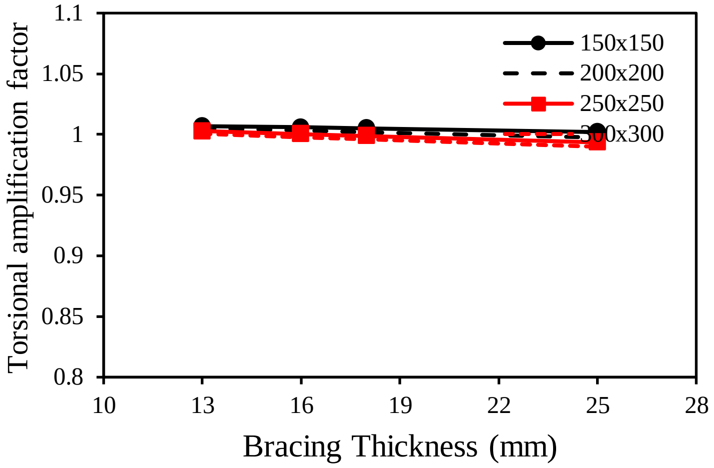

Fig. 4. 19 Torsional amplification factor for x direction earthquake force (zone-2)

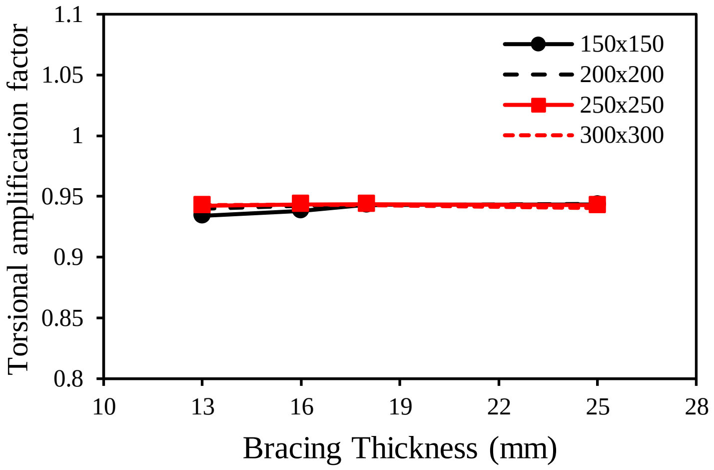

Fig. 4. 20 Torsional amplification factor for Y direction earthquake force (zone-2)

Fig. 4. 21 Torsional amplification factor for X direction response spectrum force (zone-2)

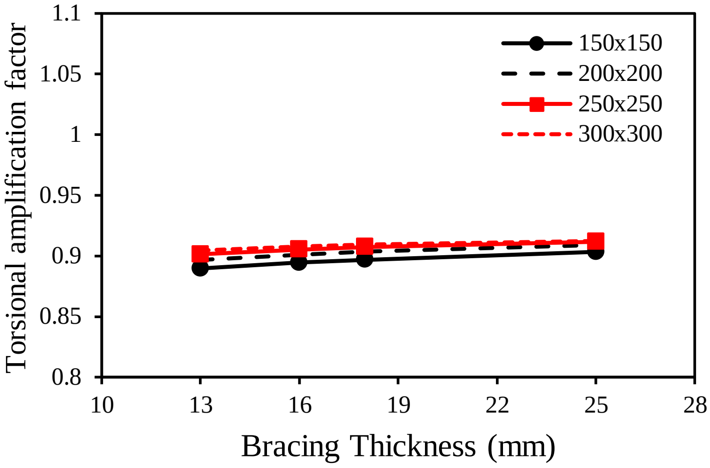

Fig. 4. 22 Torsional amplification factor for y direction response spectrum force (zone-2)

4.3.3 Zone 3

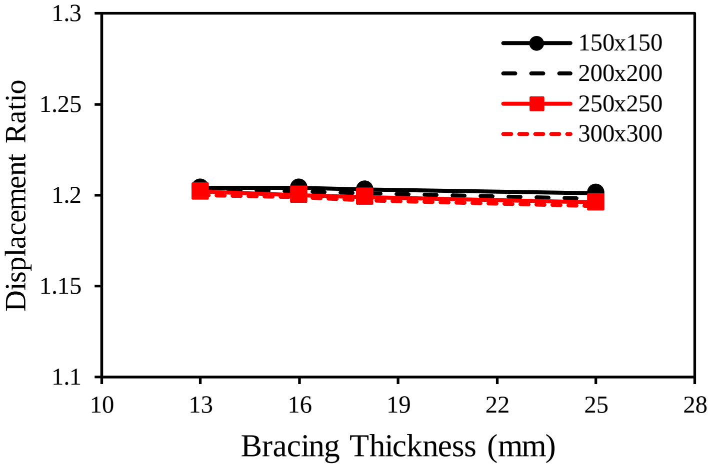

Fig. 4. 23 Displacement Ratio for x direction earthquake force (zone-3)

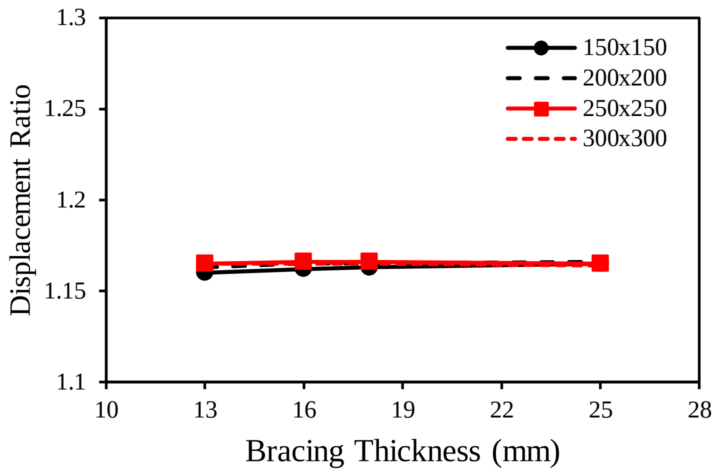

Fig. 4. 24 Displacement Ratio for x direction earthquake force (zone-3)

According to analysis result for without bracing, we were seen that the displacement ratio for the Y direction earthquake force was irregular. To reduced irregularity of RC building we started install steel X bracing (Fig. 4.1-4.6). After applied retrofitting in RC building the displacement ratio less than 1.2, which was good for structure for Y direction earthquake force (BNBC 2020)

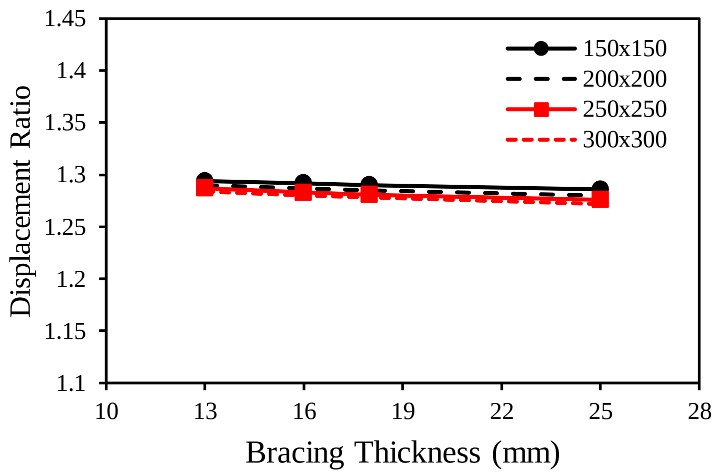

Fig. 4. 25 Displacement Ratio for x direction response spectrum force (zone-3)

There was no bracing in the building, the Displacement Ratio for X direction for the response spectrum towards the earthquake was just Ok. Later, by increasing the thickness of bracing, the value was reduced a lot.

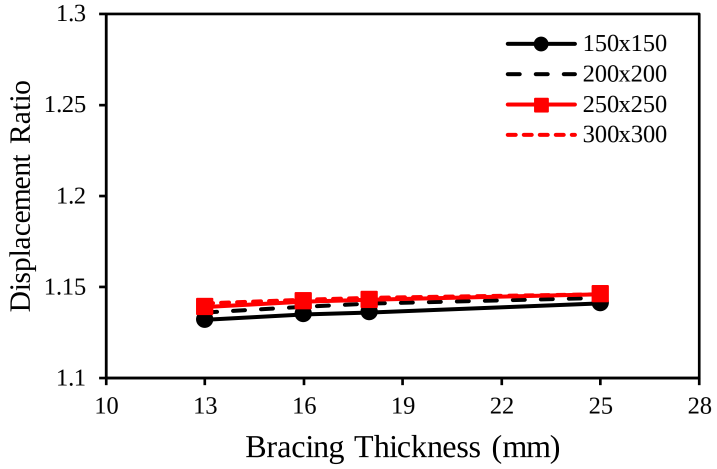

Fig. 4. 26 Displacement Ratio for y direction response spectrum force (zone-3)

The results we got from the analysis were that without bracing there was an extreme Displacement Ratio Y for the earthquake force response spectrum y. But after setting the ba-150-1 bracing size later, I saw that the Displacement Ratio Y for the earthquake force response spectrum Y was ok (BNBC 2020)

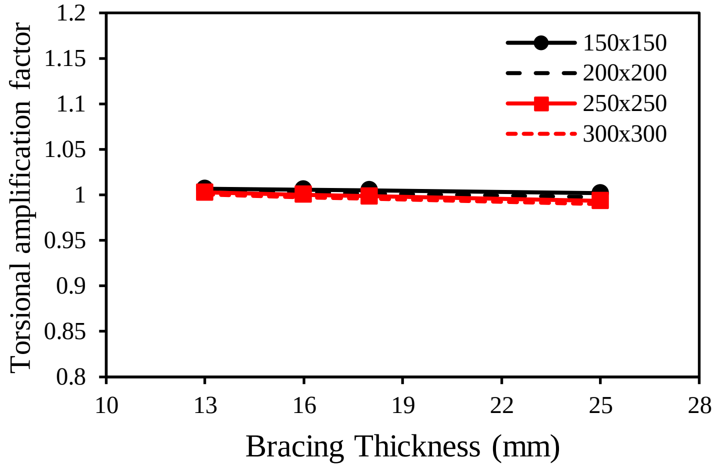

Fig. 4. 27 Torsional amplification factor for x direction earthquake force (zone-3)

Here, when we analyzed the building without a brace, we saw that the X-direction displacement ratio of the earthquake force was ok. Then when I started retrofit it with bracing, the displacement ratio became irregular. Then after we increased the bracing size the displacement ratio for the X direction of the earthquake force was ok (BNBC 2020). We was seen that B200-4 & B300-2 bracing shown minimum displacement ratio rather than other bracing Fig. 4.7.

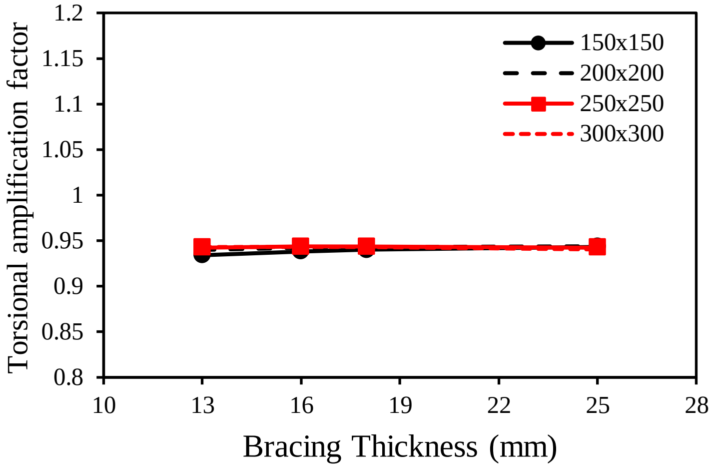

Fig. 4. 28 Torsional amplification factor for y direction earthquake force (zone-3)

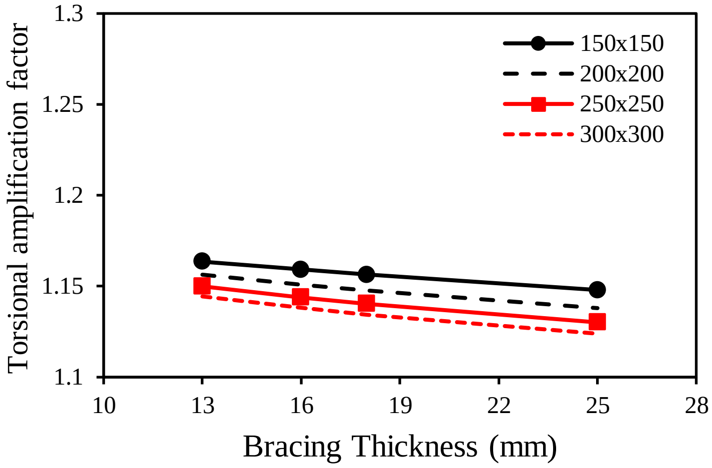

Fig. 4. 29 Torsional amplification factor for x direction response spectrum force (zone-3)

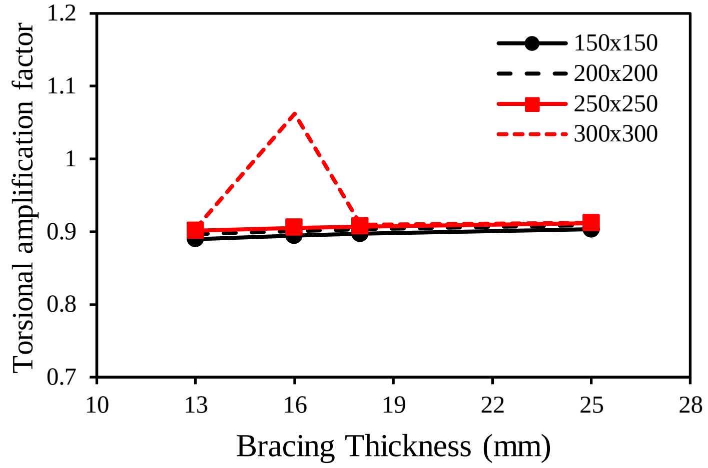

Fig. 4. 30 Torsional amplification factor for y direction response spectrum force (zone-3)

4.3.4 Zone 4

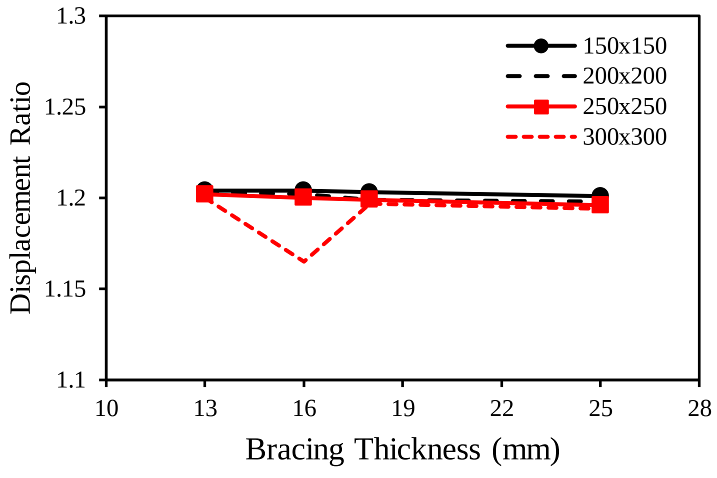

Fig. 4. 31 Displacement Ratio for X direction earthquake force (zone-4)

Here, when we analyzed the building without a brace, we saw that the X-direction displacement ratio of the earthquake force was ok. Then when I started retrofit it with bracing, the displacement ratio became irregular. Then after we increased the bracing size the displacement ratio for the X direction of the earthquake force was ok (BNBC 2020). We was seen that B200-4 & B300-2 bracing shown minimum displacement ratio rather than other bracing Fig. 4.7.

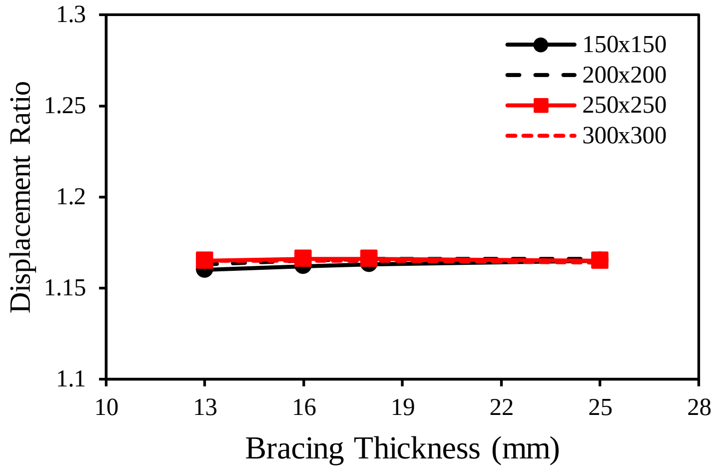

Fig. 4. 32 Displacement Ratio for Y direction earthquake force (zone-4)

There was no bracing in the building, the Displacement Ratio for Y direction for the response spectrum towards the earthquake was just Ok. (BNBC 2020).

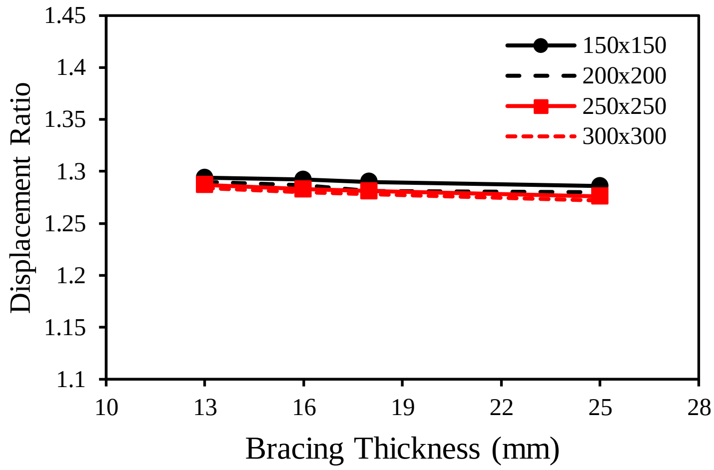

Fig. 4. 33 Displacement Ratio for x direction response spectrum force (zone-4)

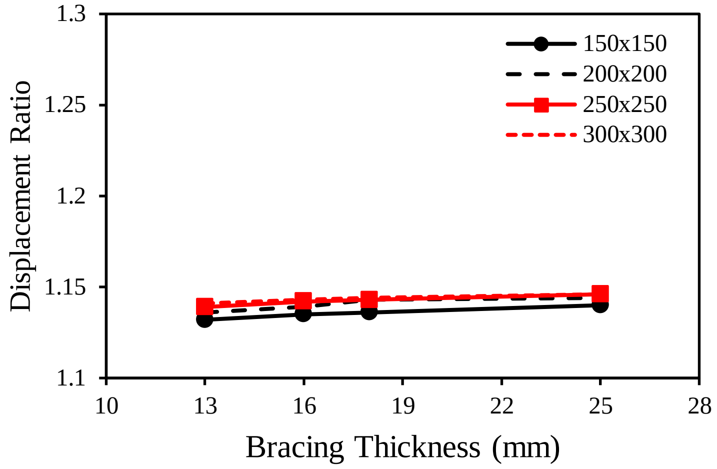

Fig. 4. 34 Displacement Ratio for y direction response spectrum force (zone-4)

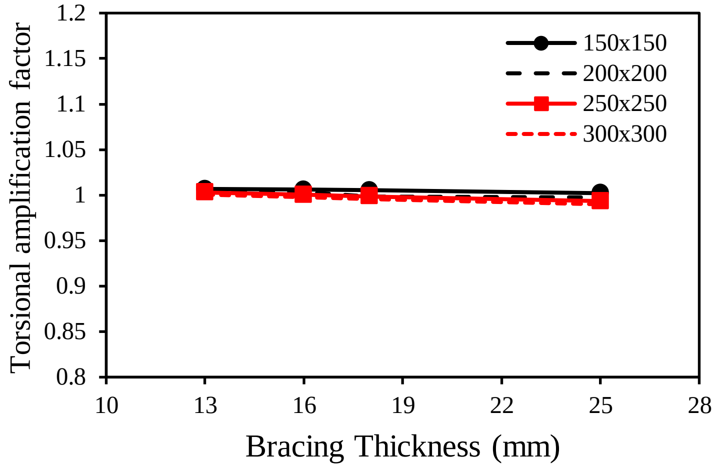

Fig. 4. 35 Torsional amplification factor for x direction earthquake force (zone-4)

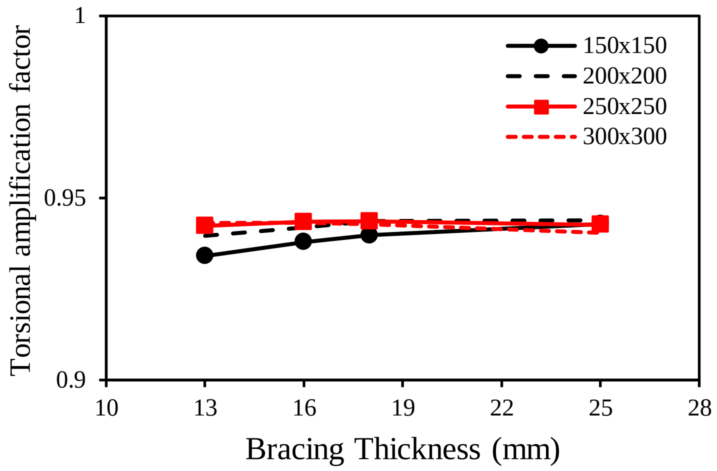

Fig. 4. 36 Torsional amplification factor for Y direction earthquake force (zone-4)

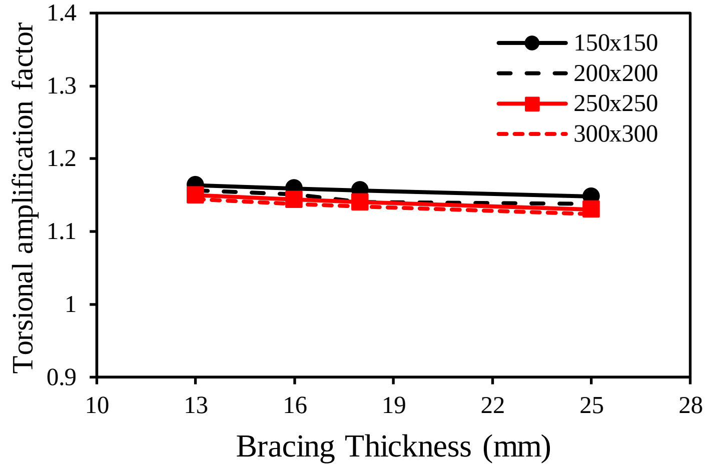

Fig. 4. 37 Torsional amplification factor for x direction response spectrum force (zone-4)

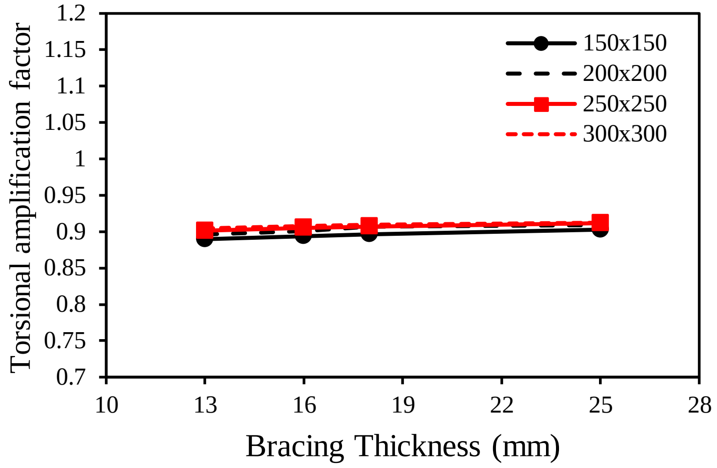

Fig. 4. 38 Torsional amplification factor for Y direction response spectrum force (zone-4)

According to the BNBC 2020 Torsional amplification factor to is good for RC building when it is value less than 3. we see that in our analysis for all zone we always get results less than 3. So there is no significant effect in Torsional amplification factor which are also seen our graph Fig. (4.11- 4.14,4.19-4.22,4.27-4.30,4.35-4.38)

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

We have done this investigation utilizing bracing to stable the structure from seismic effect. We have additionally got some dislodging proportions by doing this investigation. A portion of the discoveries of this investigation are appeared beneath.

- First we gather the displacement ratio for the earthquake force and response spectrum from the model without bracing. According to BNBC 2020 displacement ratio was irregular for earthquake force in Y direction and extreme condition for response spectrum force in Y direction.
- In All Zone with soil condition A, displacement ratio was irregular/extreme to safe condition for earthquake force Y and response spectrum force Y, because of install different size of bracing. But in X direction earthquake force and response spectrum force displacement ratio being irregular from safe condition. Later displacement ratio was good in X direction direction earthquake force due to use higher thickness and cross sectional size bracing.
- At no bracing condition X directional displacement ratio for earthquake force was ok, but after install B-150-1 the ratio become irregular. The ratio was shown safe according to BNBC 2020, when B-250-2 and remaining higher bracing size installed.

- At no bracing condition Y directional displacement ratio for earthquake force was irregular, but after install B-150-1 and higher size the ratio become Safe according to BNBC 2020.
- At no bracing condition X directional displacement ratio for response spectrum force was safe, but after install B-150-1 and higher size the ratio become irregular according to BNBC 2020.
- At no bracing condition Y directional displacement ratio for Y force was irregular, but after install B-150-1 and higher size the ratio become Safe according to BNBC 2020.
- Finally, B-250-2 Bracing is safe for Y direction earthquake and response spectrum force and also safe for X direction earthquake force condition. But B-250-2 to B-300-4 Bracing size unable to reduce displacement ratio for X direction response spectrum force.

5.2 Future Recommendation:

In this review, work has been done to expand the strength of the structure to shield it from tremors. In view of the aftereffects of the investigation and the experience acquired during the exploration, a few stages can be suggested for the improvement of this examination as depicted underneath.

- Several sorts of retrofit strategies can be utilized for better outcomes in such examinations. For example, - jacketing of segment, jacketing of shaft, adding shear divider and so on.
- It is smarter to utilize BNBC's most as of late distributed code for this review, at that point the precision pace of the study will expand a ton.
- We done our investigation with X-type supporting, V and ZX propping are additionally need to act in FEA.
- This examination will perform by T supporting rather than I propping.
- Instead of steel propping FRP or CFRP assaulting will be utilized in shaft, chunk and segment.

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