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Design of RC Building by X Bracing Frame Using ETABS

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ABSTRACT

An earthquake is a natural occurrence brought on by the abrupt release of energy from the earth's crust, which causes seismic waves. One of the biggest possible causes is earthquakes. natural disaster losses and damage to residential areas. needed restraint Existing buildings have been harmed by the earthquake. We have understood that earthquakes are catastrophic occurrences from the beginning of time. The structure is currently becoming thinner and shaking is increasing, which is negatively affecting the earthquake. To create this structure earthquake resistant in the past, scientists and engineers worked together. The employment of lateral load absorbing techniques in design configurations has been shown to significantly improve structural performance in a number of functional evaluations. In this examination, we'll examine and design a residential structure based on the G+12 building's X-braces. Both static and dynamic response spectrum analyses of structures are performed on buildings. The state of buildings is examined. The examination of residential structures was conducted using the ETABS 2015 commercial package. To compare the outcomes and choose the best course of action, we used tables and visualizations. Based on these analyses and comparison tables, concluding remarks were provided.

KEY WORDS: ETABS,STATIC ANALYSIS,DYNAMIC ANALYSIS.

1.INTRODUCTION

The main goal is to evaluate the lateral displacements, flow, base shear, and stiffness because a surprising tremor, which is better than an earthquake, is a movement of the earth's crust that is caused by shock waves from nuclear tests or artificial explosions. The remaining information relates to volcanism, the collapse of underground caverns, or man-made effects and serves as a guide for designing built-in amenities to be sufficiently earthquake resistant as a first step in disaster mitigation. Two forms of losses, referred to as primary loss and secondary loss, are explained by earthquakes. An earthquake-related major loss that is irrecoverable and affects human lifestyles. The various losses are all referred to as secondary losses. Thus, the bare minimum required by a code to withstand an earthquake is established, ensuring that no human lives are lost and preventing the entire structure from collapsing. This calls for a prediction of the greatest depth of likely ground movement at a specific location for the course of the constitution's service life. A country's seismic zoning map divides it into numerous regions with the same likely highest ground motion intensities.

1.2 ETABS

Every aspect of the engineering style technique is integrated by ETABS, starting with style conceptualization and ending with the assembling of schematic drawings. Model creation is much simpler thanks to intuitive drawing tools that quickly generate floor and elevation framing. CAD drawings are frequently converted into ETABS models directly or used as templates onto which ETABS objects can be superimposed. The cutting-edge SAP fireplace 64-bit problem solver provides nonlinear modeling techniques like construction sequencing and time effects (such as creep and shrinkage) and enables the rapid analysis of extremely large and complex models.

Whether structural engineers are designing one-story industrial buildings or the highest commercial high-rises, ETABS offers an unmatched set of capabilities. Since its launch decades ago, ETABS has been known for being incredibly powerful yet simple to use. This most recent iteration carries on that tradition by giving engineers the cutting-edge tools they need to be as productive as possible.

A. Modeling of Structural System

B. Loading, Analysis and Design

C. Output, Interoperability and Versatility

2.LITERATURE REVIEW

Hussain Imran K.M and Sowjanya G.V (2014):

studied the stability analysis of braced and unbraced rigid steel frames in relation to seismic and wind loads. They used ETABS to compare the responses of buildings with and without bracing systems when exposed to seismic load and wind load. For this experiment, they used five models, one without a bracing structure and four models with various bracing systems. According to IS 1893:2002, an analogous static analysis is performed on the model. According to IS 875 (part 3): 1987, the impact of wind loads on structural systems is assessed and compared. Finally, they came to the conclusion that X-type bracings are a very effective sort of bracing style for strongly seismic regions and for various wind speeds.

Dr. Okay. R. C. Reddy, Sandip A. Tupat Et., AI. (2014):

According to his research, the anticipated wind and earthquake masses for a twelve-story RC-framed structure**.** The following conclusions are drawn based on the results obtained. The height of the constitution causes the earthquake and wind hundreds to increase. For towering structures, wind loads are more valuable than seismic loads. Constructions must be planned for loads obtained independently from each guideline for significant earthquake or wind forces.

3.METHODOLOGY

It's crucial to adhere to a methodical approach when working on a design project employing ETABS (Extended Three-Dimensional Analysis of Building Systems) in order to provide accurate and effective results. The following methodology is suggested for an ETABS design project:

1. Project Definition and Data Collection:

• Specify the project's goals, restrictions, and scope.

• Gather pertinent project specs, structural and architectural drawings.

• Gather information on the necessary loading, such as the dead and live loads, wind and earthquake loads, etc.

2. Model Creation:

• In ETABS, create the geometry of the building, including the floor plans, the columns, beams, slabs, walls, and other structural elements.

• Choose the suitable materials for each element, taking concrete, steel, and other qualities into account.

• Specify the structure's support requirements, such as fixed supports, pinned supports, etc.

3. Load Definition:

• Add gravity loads to the model, including living loads (occupation, furniture, and equipment) as well as dead loads (one's own weight, finishes, and partitions).

• Apply lateral loads, such as seismic and wind loads, in accordance with the design code and project requirements.

4. Analysis:

• Based on the project requirements, analyze the structure using the relevant methods (e.g., linear static analysis, response spectrum analysis, time history analysis).

• Verify the stability, displacements, stresses, and other pertinent parameters in the analysis results.

5. Design:

• Calculate the necessary design moments and forces for each structural element, such as foundations, slabs, columns, and beams.

• Compare the design forces to the capacity of the elements while taking into account the applicable design standards and norms.

• Size the structural components in accordance with the design specifications, taking into account elements such as member depth, reinforcing details, and spacing.

6. Iterative Process:

• Assess the design, pinpoint any flaws or potential improvement areas, and adjust the model as appropriate.

• Keep going back to stages 4 and 5 until you find a good design solution.

7. Documentation and Reporting:

• Create thorough design calculations, drawings, and reports that detail the design technique, underlying assumptions, outcomes, and suggested improvements.

• Specify the sizes of the members, the specifications of the reinforcement, and any extra design considerations in detail.

8. Review and Approval:

• Discuss the design with the necessary parties, such as the project owners, structural engineers, and architects.

• Respond to any suggestions or amendments made by the reviewers.

• Get the design's final approval.

It's vital to keep in mind that this methodology should only be used as a broad guide; the specific procedures may change based on the project's complexity and requirements, as well as the design laws and standards that apply in your area.

3.1 MATERIALS AND GEOMETRICAL PROPERTIES:

S.No	DESCRIPTION PARAMETER	
01	Depth of Foundation	3.0m
02	Floor to Floor Height	3.0m
03	Grade of Concrete	M35
04	Grade of Steel	Fe 550
		Fe 415
05	Column Sizes	1600mm X 1800mm For Story 01
		1400mm X 1500mm For Story 2 to Story 7
		900mm X 1000mm For Story 8 to Story 12
06	Beam Sizes	800mm X 900mm For Story1 to Story 6
		700mm X 800mm For Story7 to Story 12
07	Slab Thickness	150mm Thickness
08	Type of Bracing	ISMB 175
09	Type of Damper	Viscous Damper 250
		Weight – 41Kgs
		Force – 250Kn
10	External Wall Thickness	230mm
11	Internal Wall Thickness	125mm
12	Plan Dimension	39.3m X 34.8m
13	Total Plan Area	1367.64m^2
14	Seismic Zone	Zone - 4
15	Zone Factor	0.24
16	Importance Factor	1.0
17	Response Reduction Factor	5.0
18	Percentage of Damping	5%
19	Type of Soil	Medium Soil

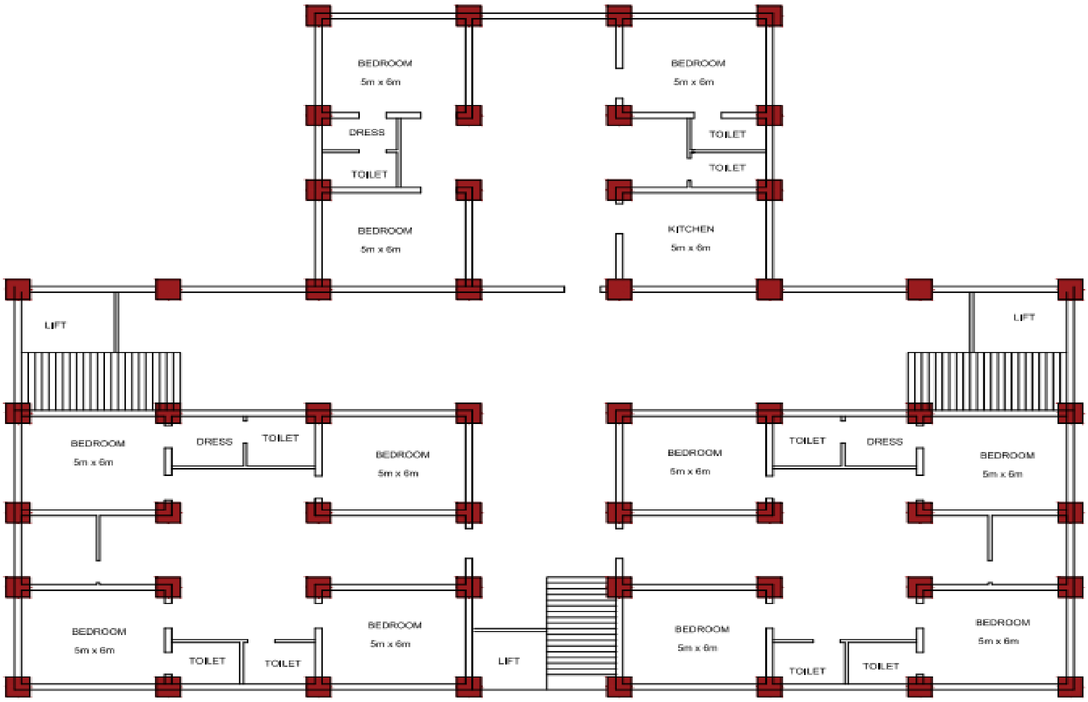
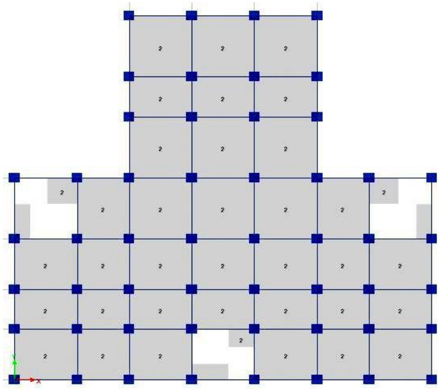
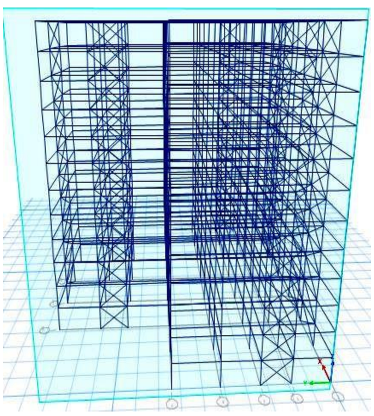
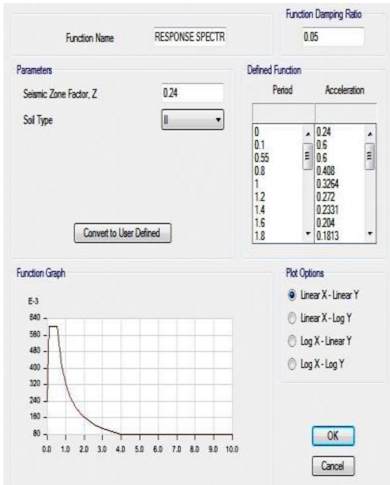


Fig 3.1 Residential plan with column layout

4. ETABS PROCEDURE

Assignment of loads	Assignment of X Bracing	Define Response spectrum
		

5. RESULTS

5.1 STATIC ANALYSIS WITHOUT X BRACING

Table 5.1 Displacement Without X bracing

STORY No	DISPLACEMENT in mm
STORY 12	15.638
STORY 11	13.736
STORY 10	11.886
STORY 09	10.079
STORY 08	8.335
STORY 07	6.712
STORY 06	5.203
STORY 05	3.876
STORY 04	2.721
STORY 03	1.795
STORY 02	1.203
STORY 01	1.012
BASE	0

Graph 5.1 Displacement Without X bracing

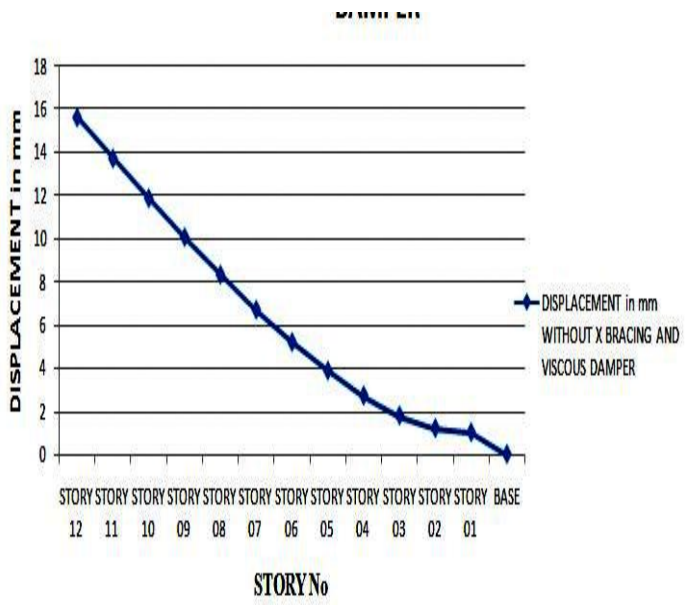
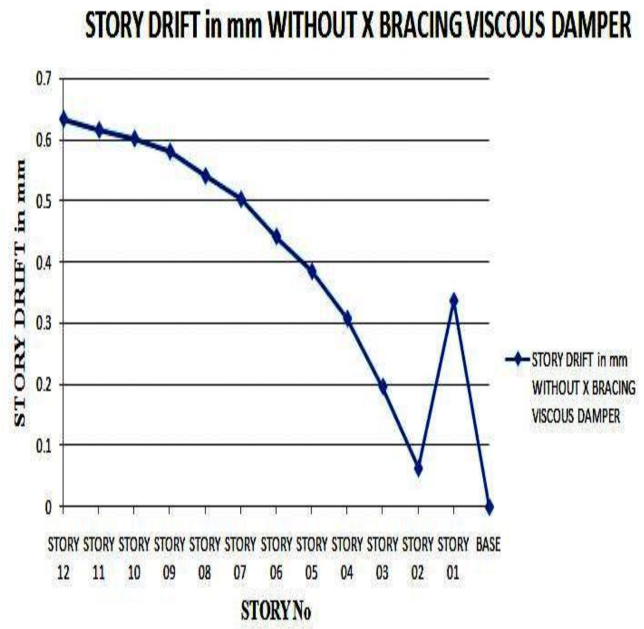


Table 5.2 Story Drift Without X bracing

STORY No	STORY DRIFT mm
STORY 12	0.634
STORY 11	0.616
STORY 10	0.602
STORY 09	0.581
STORY 08	0.541
STORY 07	0.503
STORY 06	0.442
STORY 05	0.385
STORY 04	0.308
STORY 03	0.197
STORY 02	0.063
STORY 01	0.337
BASE	0

Graph 5.2 Story Drift Without X bracing



5.2 DYNAMIC ANALYSIS WITHOUT X BRACIING

Table 5.3Displacement Without X bracing

STORY No	DISPLACEMENT in mm
STORY 12	12.867
STORY 11	12.329
STORY 10	11.342
STORY 09	10.175
STORY 08	8.789
STORY 07	7.293
STORY 06	5.984
STORY 05	4.724
STORY 04	3.516
STORY 03	2.383
STORY 02	1.348
STORY 01	0.519
BASE	0

Graph 5.3 Displacement Without X bracing

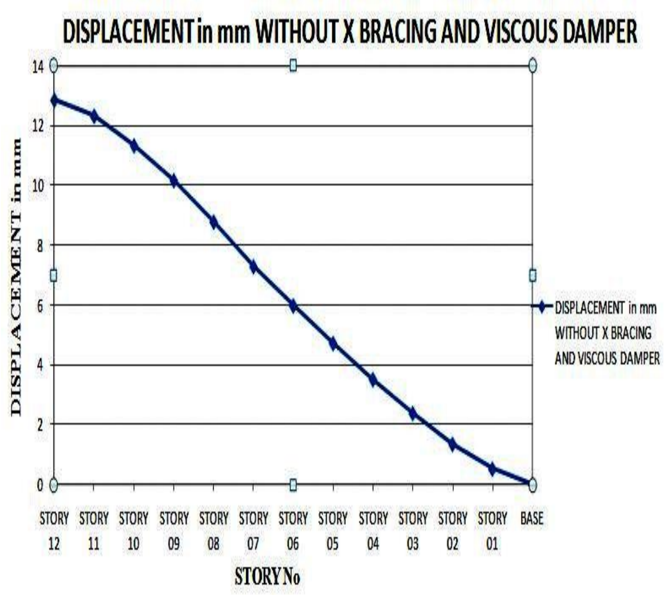
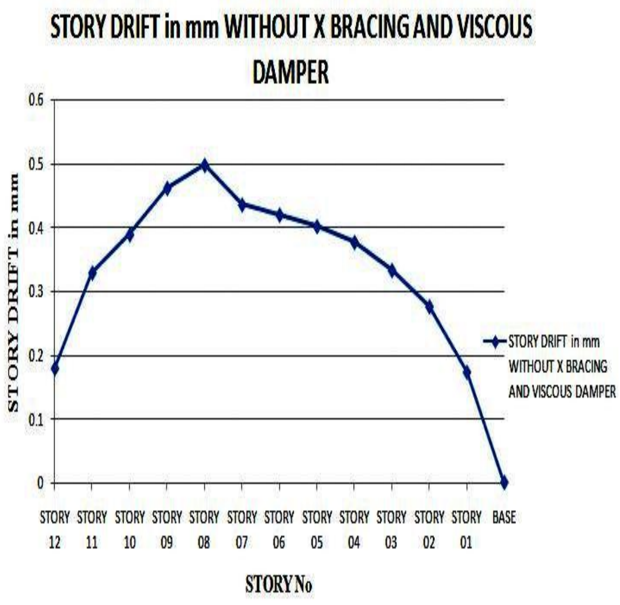


Table 5.4 Story Drift Without X bracing

STORY No	STORY DRIFT in mm
STORY 12	0.179
STORY 11	0.329
STORY 10	0.389
STORY 09	0.462
STORY 08	0.498
STORY 07	0.436
STORY 06	0.420
STORY 05	0.402
STORY 04	0.377
STORY 03	0.333
STORY 02	0.276
STORY 01	0.173
BASE	0

Graph 5.4 Story Drift Without X bracing



5.3 STATIC ANALYSIS WITH X BRACING

Table 5.5 Displacement With X bracing

STORY No	DISPLACEMENT in mm
STORY 12	0.503
STORY 11	0.409
STORY 10	0.340
STORY 09	0.276
STORY 08	0.243
STORY 07	0.117
STORY 06	0.140
STORY 05	0.120
STORY 04	0.105
STORY 03	0.097
STORY 02	0.097
STORY 01	0.088
BASE	0

Graph 5.5 Displacement With X bracing

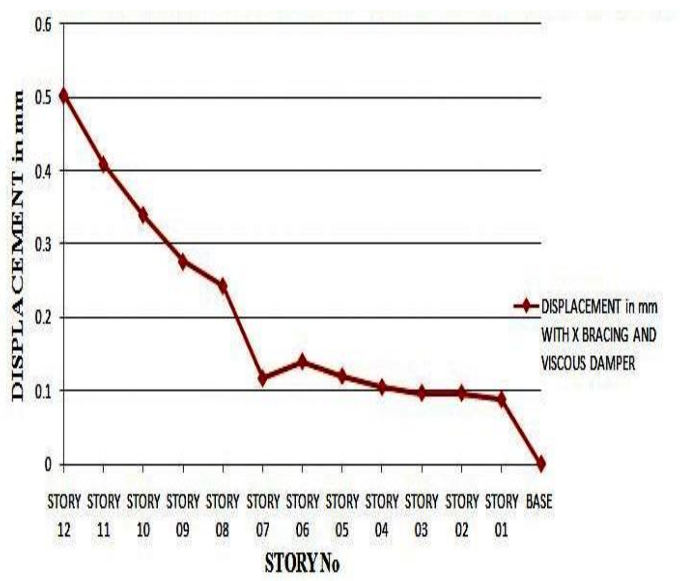
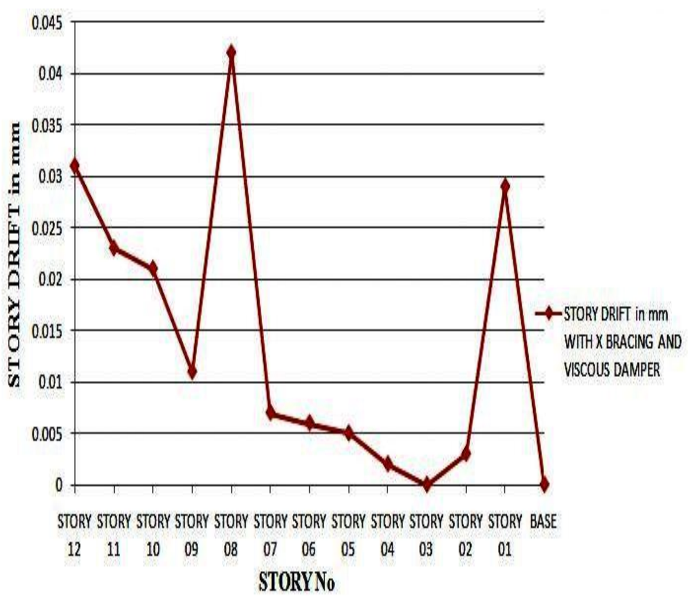


Table 5.6 Story Drift With X bracing

STORY No	STORY DRIFT in mm
STORY 12	0.031
STORY 11	0.023
STORY 10	0.021
STORY 09	0.011
STORY 08	0.042
STORY 07	0.007
STORY 06	0.006
STORY 05	0.005
STORY 04	0.002
STORY 03	0.000
STORY 02	0.003
STORY 01	0.029
BASE	0

Graph 5.6 Story Drift in mm With X bracing



5.4 DYNAMIC ANALYSIS WITH X BRACING

Table 5.7 Displacement With X bracing

STORY No	DISPLACEMENT in mm
STORY 12	9.223
STORY 11	8.331
STORY 10	7.403
STORY 09	6.421
STORY 08	5.395
STORY 07	4.368
STORY 06	3.377
STORY 05	2.456
STORY 04	1.619
STORY 03	0.906
STORY 02	0.378
STORY 01	0.094
BASE	0

Graph 5.7 Displacement With X bracing

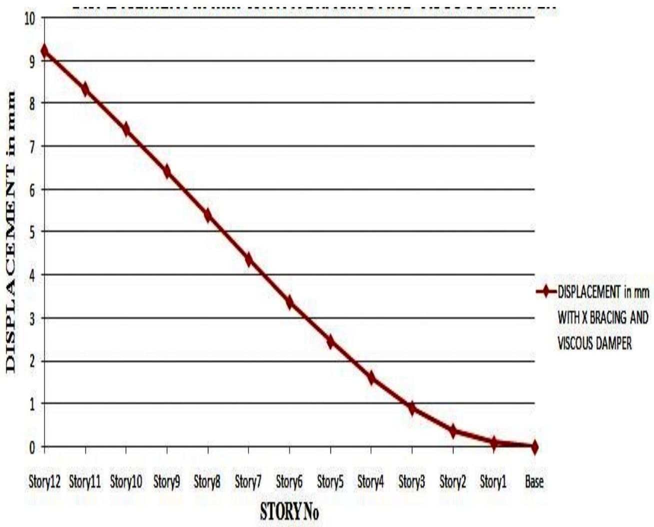
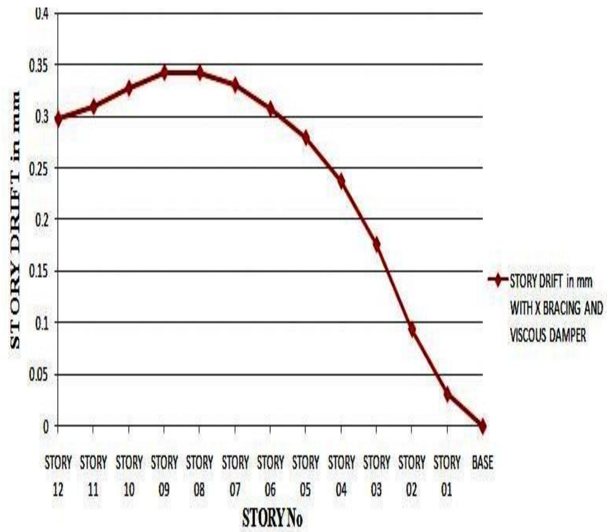


Table 5.8 Story Drift With X bracing

STORY No	STORY DRIFT in mm
STORY 12	0.297
STORY 11	0.309
STORY 10	0.327
STORY 09	0.342
STORY 08	0.342
STORY 07	0.330
STORY 06	0.307
STORY 05	0.279
STORY 04	0.237
STORY 03	0.176
STORY 02	0.094
STORY 01	0.031
BASE	0

Graph 5.8 Story Drift With X bracing



6. CONCLUSION

1.In static analysis, the building's X bracing and viscous damper entirely reduce displacement.

2. Building with X bracing lowers story drift by 85%.

3. By adding X bracing, the displacement in a dynamic analysis is minimized by 75%.

4. By using X bracing, the tale drift is gradually decreasing from story to story.

The displacement and story drift in the typical building are fully reduced by adding X bracing.

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