"Analysis of RC Building Frame With and Without Masonry Infill Walls"

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Abstract - *In countries like India where seismic activity is widespread, reinforced concrete frames with masonry infill walls are a popular technique. In structural analysis, brick walls are usually considered non-structural elements; only their mass fraction is considered and their structural properties such as strength and stiffness are usually ignored. Structures in seismically active areas are very susceptible to severe damage. In addition to bearing capacity, the structure must withstand lateral loads, which can cause significant stresses. Reinforced concrete frames are the most used building materials in the world today. The frames of a framed structure are often filled with rigid materials such as brick or concrete block, usually to form an envelope. In this research paper, we analyze the structure of a G+23-story rectangular 32mx24 base multi-story building with each floor height of 3.2m and various parameters such as slab thickness of 150mm, masonry infill support panel height of 390mm and width of 230mm, external column size 600 mm x 700 mm, internal column size 500 x 600 mm, beam size 500 x 700 mm, with IS code. The four analyzed models, such as Model-I without infill wall structure, Model-II and Model-III are masonry infill walls due to the use of corresponding diagonal support panels such as eccentric rear and eccentric front type, while Model IV diagonal or X -type masonry infill the walls use support panel. In this research, RCC frame structure with and without infill wall is analyzed using Etabs 2021 software and parameters such as seismic zone V, average soil condition, response reduction factor 5, significance factor 1.5 for major building etc. IS-1983. and run four models using the corresponding spectral method with Etabs 2021 software Sum all results in the layer displacement period.*

Key Words: RCC Structure, Masonry infill, RCC frame, Seismic analysis, Seismic Zone, Soil Condition, Etabs Software.

1.INTRODUCTION

This file serves as a template, Masonry infill panels are being used in the construction of many Indian structures for both utilitarian and architectural purposes. Masonry infill walls are often regarded as non-structural elements, and in practice—that is, when the building is intended for loading—their stiffness components are typically disregarded. But when lateral stresses are placed on the structure, infill walls often interact with the frame and also exhibit energy-dissipating qualities when subjected to seismic loads. When lateral loads are applied, masonry walls make the infill more rigid. A composite construction made up of infill walls and a moment-resisting planar frame is referred to as a "infill frame".

Masonry walls are used to create segregation and/or seclusion in the majority of reinforced concrete frame buildings. Since the infill wall is thought to be load-free in conventional practice, its involvement in the analysis and design of the structure is disregarded, and the infill's self-weight is taken into account when designing other structural components. On the other hand, very high initial lateral stiffness and poor ductility were seen in frames with MI walls. The lateral load transmission mechanism of the structure shifts from a dominating frame action to a dominant lattice effect when the frames are filled with brick walls. This causes the bending moments and axial forces in the frame members to diminish.

1.1 Objective of Work

- To investigate the structural analysis effects of G +23 layered structure with and without infill wall.
- To investigate the effect of masonry infill on the stiffness of the structure.

1.2 building Plan Configuration

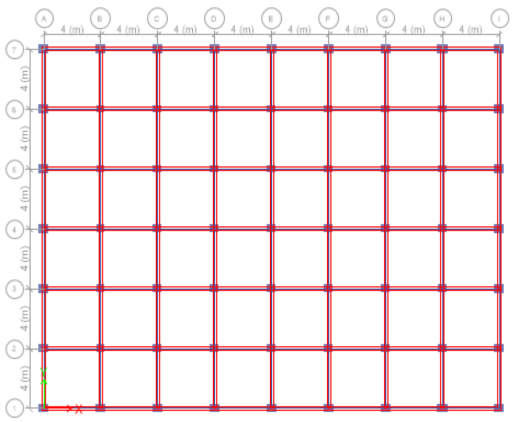

Fig. 1.1 Plan

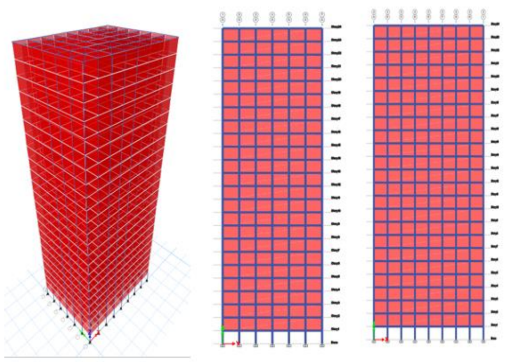

Fig. 1.1a 3D view MODEL-I Fig. 1.1b Without Infill Wall

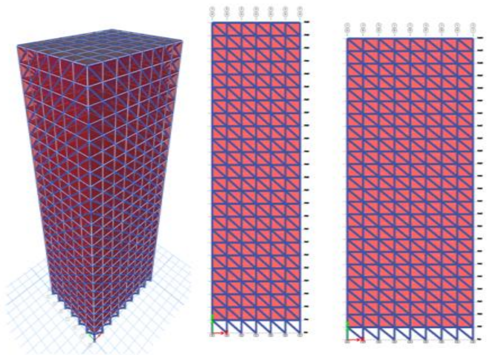

Fig. 1.2a 3D view MODEL-II Fig. 1.2b Masonry Infill Walls

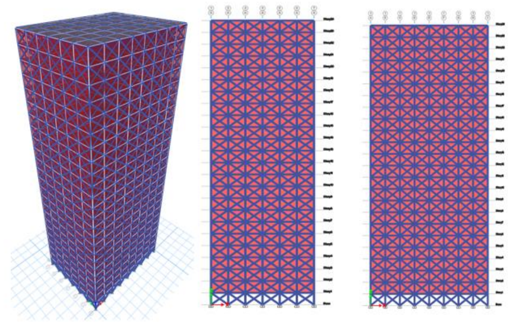

Fig. 1.4a 3D view MODEL-IV Fig. 1.4b Masonry Infill Walls

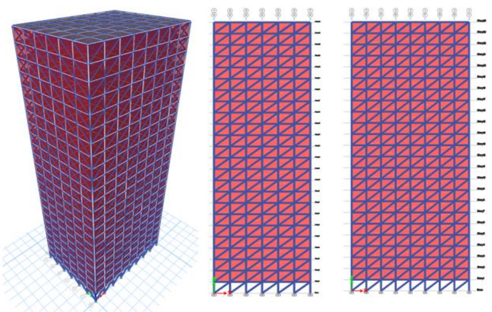

Fig. 1.3a 3D view MODEL-III Fig. 1.3b Masonry Infill Walls

2. LITERATUR

S. Vijayalakshmi, J. Saibaba (2022) - Using the structural analyzer E-TABS, they examined the three-dimensional analytical model of the G+10 multi-story building for several building models. All the significant elements that influence the mass, strength, and stiffness of the structure are included in the analytical construction model. To assess the capacity, demand, and efficiency of the model under discussion, the research combines seismic analysis with non-linear static (push) and linear dynamic (response spectrum approach) processes. Despite the brittle failure modes of the wall, they infer from the thrust analysis of the models that the initial stiffness and strength of the packed frame rises compared to the bare frame. But compared to the bare frame, it fails at a comparatively lower slip threshold. **Trupti S. Shewalkar, Amey R. Khedikar (2019) -** Using STAAD Pro V8i software, they examined a G+10 storey RCC frame building with and without an infill wall. The support width was manually determined in accordance with the FEMA-356 provision. When compared to the bare frame, they discovered that the infill had a considerable impact on the structure and increased rigidity, which helped the building endure the seismic zone. **Shriyanshu Swarnkar, Dr. Debarati Datta (2015) -** They looked at various designs for 4, 8, and 12 story structures that raised a base by three to six on empty and filled frames. They then assessed each design using a variety of techniques, including response spectrum analysis, equivalent static method, and nonlinear static impulse analysis. In the pusher analysis, it was demonstrated that as the building's height and number of openings rise, so does the base's displacement capacity. Additionally, the time periods increase in tandem with these developments. The overall rigidity of the structure rises with the number of legs. d) The behavior of the structure turns from ductile to rigid with the addition of fillers. It is harder for bare structures than for filled ones.

3. MATHODOLOGY

- IRJET Open Etabs Software.
- Creating Modelling of RC building
- Applying property like beam, column, slab dimension and support on structure.
- Applying Load like Dead load, Live load, seismic load and load combination as per IS code.
- Getting Various Results
- Results Analysis
- Conclusion

4. PROBLEM FORMULATION

RC buildings with and without masonry infill walls are the type of buildings. Building Plan Configuration: Floor height: 3.2 meters, 24 by 32 meters of G+23 Four meters separates the bays in each direction, and there are six and eight bays in total. Property: The outer and inner columns measure 600 by 700 mm and the beams 500 by 700 mm, respectively. The thickness of the slab is 150 mm, and the strut for the masonry infill walls measures 390 by 230 mm. Seismic Analysis Techniques: Response Spectrum Analysis Building shape: rectangular; number of models: four (two with and without infill walls positioned differently). The symmetric seismic parameter is the type of structure.

: Masonry infill walls and RC buildings are the same type of structure. G+23 (a building with a rectangular shape) has the most floors. For mediums, use the soil site factor 2 and seismic zone-V and zone factor Z=0.36. soil circumstances, Damping Ratio 5% (according to Table 3 Clause 6.4.2), Importance Factor I = 1.5 (according to Table 6's Important Structure), Table 7 shows the Response Reduction Factor (R=5) for the special steel moment-resistant frame. Average coefficient of acceleration (Sa/g) is dependent on the Natural Fundamental Period. The grades of steel are Fe-345, rebar is graded Fe-415, and concrete is graded M25. Dead loads for slabs are 3.75 KN/m2 and walls are 14.375 KN/m.

Table:4.1 Structural modeling specification of G+Y Buildings

Type of Structure	RC Structure Without Infill Wall	RC Structure With Infill Walls
Bay Width in longitudinal direction	32m	32m
Bay Width in Transverse direction	24m	24m
Total Height	76.80 m	76.80 m
Live Load	3.0 KN/m2	3.0 KN/m2
Floor Finishing	1.0 KN/m²	1.0 KN/m²
Wall Load	14.375 KN/m	3.75 KN/m
Grade of concrete	M-25	M-25
Type of Rebar	Fe-415	Fe-415
Type of steel	Fe-345	Fe-345
Each floor height	3.2 m	3.2 m
Support condition	Fixed	Fixed

5. RESULTS ANALYSIS

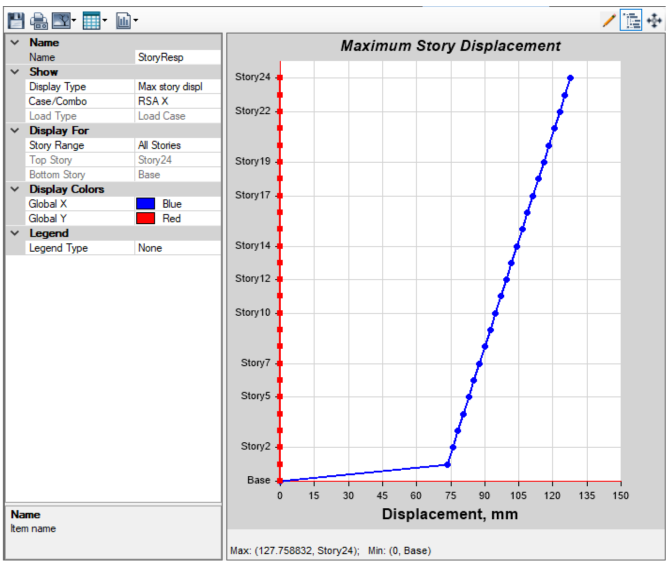

Fig.-5.1 Maximum Displacement (mm) in X direction

Table-5.1Maximum Displacement (mm) in X direction

MODEL-I (G+23), MAXIMUM STOREY DISPACEMENT IN X-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	127.759
Story23	73.6	125.402
Story22	70.4	123.045
Story21	67.2	120.686
Story20	64	118.327
Story19	60.8	115.967
Story18	57.6	113.606
Story17	54.4	111.245
Story16	51.2	108.884
Story15	48	106.522
Story14	44.8	104.161
Story13	41.6	101.799
Story12	38.4	99.438
Story11	35.2	97.077
Story10	32	94.716
Story9	28.8	92.357
Story8	25.6	89.998
Story7	22.4	87.64
Story6	19.2	85.284
Story5	16	82.929
Story4	12.8	80.576
Story3	9.6	78.224
Story2	6.4	75.877
Story1	3.2	73.539
Base	0	0

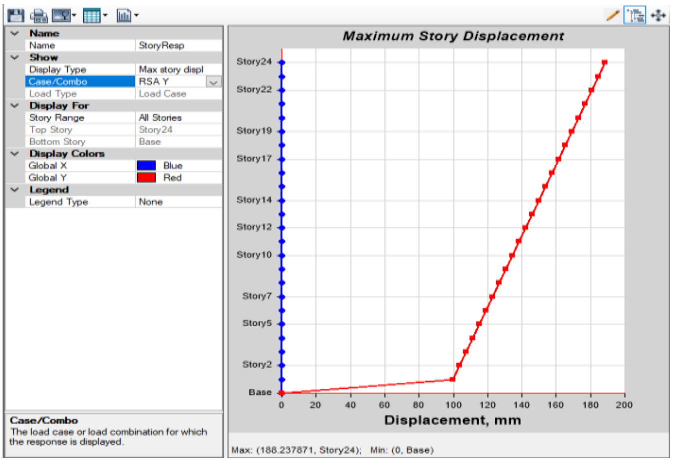

Fig.- 5.2 Maximum Displacement (mm) in Y direction

Table- 5.2 Maximum Displacement (mm) in Y dir.

MODEL-I (G+23), MAXIMUM STOREY DISPACEMENT IN Y-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	188.238
Story23	73.6	184.387
Story22	70.4	180.536
Story21	67.2	176.683
Story20	64	172.83
Story19	60.8	168.976
Story18	57.6	165.122
Story17	54.4	161.267
Story16	51.2	157.413
Story15	48	153.559
Story14	44.8	149.705
Story13	41.6	145.852
Story12	38.4	142.001
Story11	35.2	138.15
Story10	32	134.301
Story9	28.8	130.454
Story8	25.6	126.609
Story7	22.4	122.767
Story6	19.2	118.927
Story5	16	115.091
Story4	12.8	111.257
Story3	9.6	107.426
Story2	6.4	103.597
Story1	3.2	99.771
Base	0	0

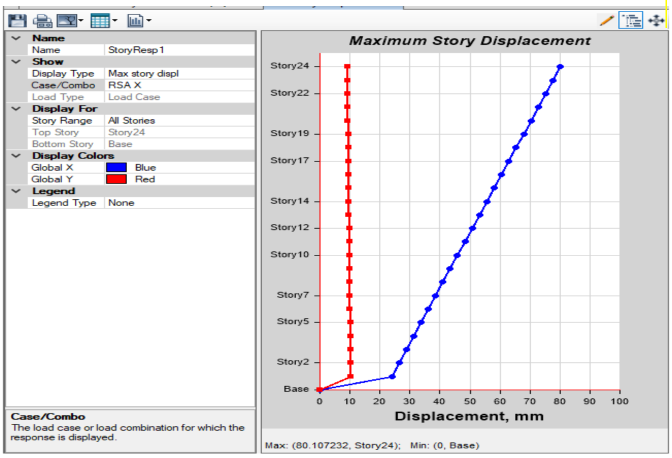

Fig.-5.3 Maximum Displacement (mm) in X direction

Table-5.3 Maximum Displacement (mm) in X direction

MODEL-II (G+23), MAXIMUM STOREY DISPACEMENT IN X-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	80.107
Story23	73.6	77.662
Story22	70.4	75.215
Story21	67.2	72.768
Story20	64	70.32
Story19	60.8	67.872
Story18	57.6	65.423
Story17	54.4	62.975
Story16	51.2	60.526
Story15	48	58.077
Story14	44.8	55.629
Story13	41.6	53.181
Story12	38.4	50.735
Story11	35.2	48.289
Story10	32	45.845
Story9	28.8	43.403
Story8	25.6	40.963
Story7	22.4	38.527
Story6	19.2	36.093
Story5	16	33.663
Story4	12.8	31.238
Story3	9.6	28.818
Story2	6.4	26.407
Story1	3.2	24.007
Base	0	0

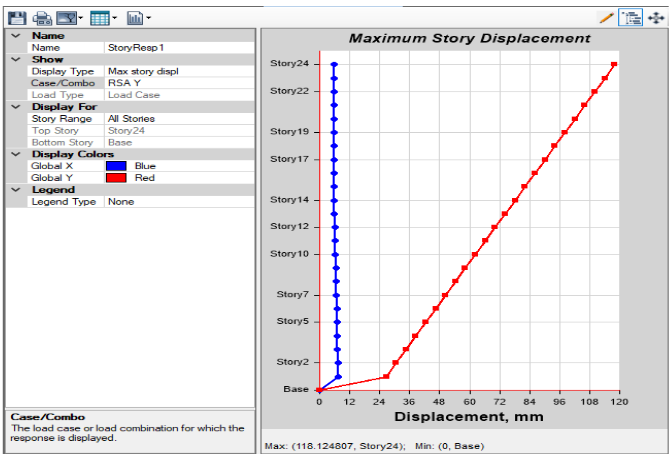

Fig.-5.4 Maximum Displacement (mm) in Y direction

Table-5.4 Maximum Displacement (mm) in Y direction

MODEL-II (G+23), MAXIMUM STOREY DISPACEMENT IN Y-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	118.125
Story23	73.6	114.138
Story22	70.4	110.15
Story21	67.2	106.161
Story20	64	102.172
Story19	60.8	98.183
Story18	57.6	94.193
Story17	54.4	90.204
Story16	51.2	86.215
Story15	48	82.226
Story14	44.8	78.238
Story13	41.6	74.251
Story12	38.4	70.266
Story11	35.2	66.282
Story10	32	62.301
Story9	28.8	58.323
Story8	25.6	54.348
Story7	22.4	50.377
Story6	19.2	46.411
Story5	16	42.451
Story4	12.8	38.499
Story3	9.6	34.555
Story2	6.4	30.623
Story1	3.2	26.708
Base	0	0

Table-5.5 Maximum Displacement (mm) in X direction

MODEL-III (G+23), MAXIMUM STOREY DISPACEMENT IN X-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	80.107
Story23	73.6	77.662
Story22	70.4	75.215
Story21	67.2	72.768
Story20	64	70.32
Story19	60.8	67.872
Story18	57.6	65.423
Story17	54.4	62.975
Story16	51.2	60.526
Story15	48	58.077
Story14	44.8	55.629
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Story10	32	45.845
Story9	28.8	43.403
Story8	25.6	40.963
Story7	22.4	38.527
Story6	19.2	36.093
Story5	16	33.663
Story4	12.8	31.238
Story3	9.6	28.818
Story2	6.4	26.407
Story1	3.2	24.007
Base	0	0

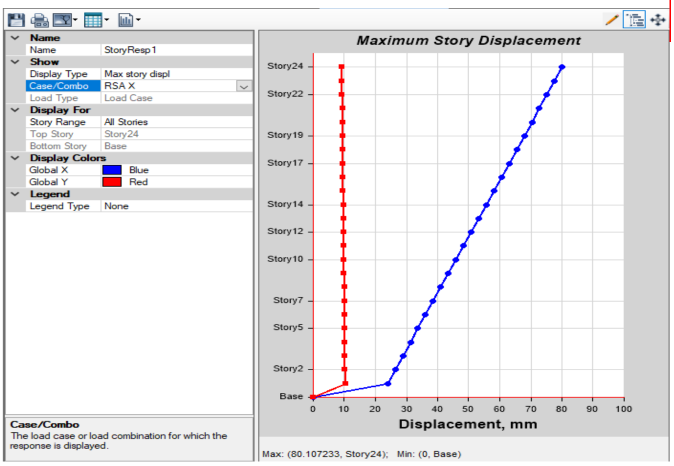

Fig.-5.5 Maximum Displacement (mm) in X direction

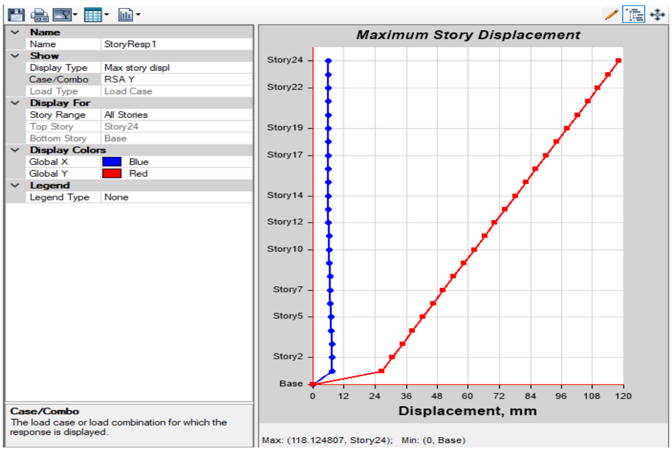

Fig.-5.6 Maximum Displacement (mm) in Y direction

Table-5.6 Maximum Displacement (mm) in Y direction

MODEL-III (G+23), MAXIMUM STOREY DISPACEMENT IN Y-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	118.125
Story23	73.6	114.138
Story22	70.4	110.15
Story21	67.2	106.161
Story20	64	102.172
Story19	60.8	98.183
Story18	57.6	94.193
Story17	54.4	90.204
Story16	51.2	86.215
Story15	48	82.226
Story14	44.8	78.238
Story13	41.6	74.251
Story12	38.4	70.266
Story11	35.2	66.282
Story10	32	62.301
Story9	28.8	58.323
Story8	25.6	54.348
Story7	22.4	50.377
Story6	19.2	46.411
Story5	16	42.451
Story4	12.8	38.499
Story3	9.6	34.555
Story2	6.4	30.623
Story1	3.2	26.708
Base	0	0

Table-5.7 Maximum Displacement (mm) in X direction

MODEL-IV (G+23), MAXIMUM STOREY DISPACEMENT IN X-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	64.857
Story23	73.6	62.529
Story22	70.4	60.2
Story21	67.2	57.87
Story20	64	55.539
Story19	60.8	53.208
Story18	57.6	50.876
Story17	54.4	48.544
Story16	51.2	46.211
Story15	48	43.879
Story14	44.8	41.547
Story13	41.6	39.216
Story12	38.4	36.886
Story11	35.2	34.557
Story10	32	32.23
Story9	28.8	29.905
Story8	25.6	27.582
Story7	22.4	25.262
Story6	19.2	22.946
Story5	16	20.634
Story4	12.8	18.328
Story3	9.6	16.028
Story2	6.4	13.737
Story1	3.2	11.459
Base	0	0

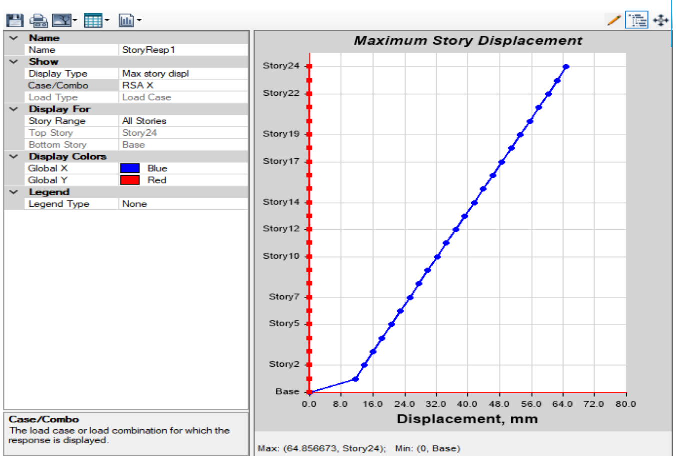

Fig.-5.7 Maximum Displacement (mm) in X direction

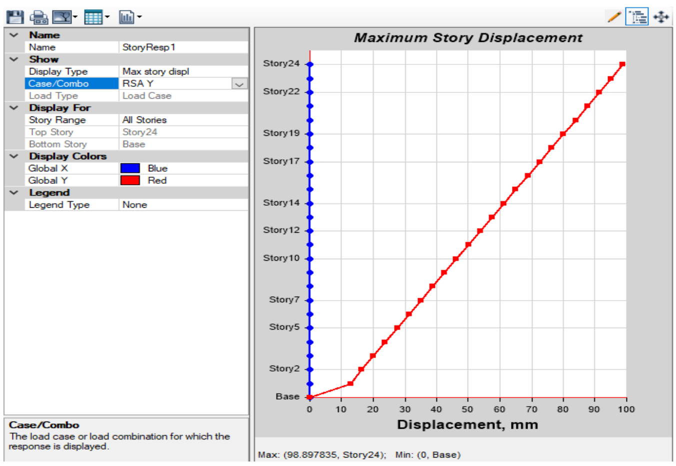

Fig.-5.8 Maximum Displacement (mm) in Y direction

Table-5.8 Maximum Displacement (mm) in Y direction

MODEL-IV (G+23), MAXIMUM STOREY DISPACEMENT IN Y-DIRECTION IN MM		
Storey	**Storey Height (m)**	**Displacement (mm)**
Story24	76.8	98.898
Story23	73.6	95.139
Story22	70.4	91.379
Story21	67.2	87.618
Story20	64	83.856
Story19	60.8	80.093
Story18	57.6	76.33
Story17	54.4	72.567
Story16	51.2	68.804
Story15	48	65.042
Story14	44.8	61.28
Story13	41.6	57.521
Story12	38.4	53.763
Story11	35.2	50.007
Story10	32	46.254
Story9	28.8	42.504
Story8	25.6	38.759
Story7	22.4	35.018
Story6	19.2	31.283
Story5	16	27.555
Story4	12.8	23.835
Story3	9.6	20.127
Story2	6.4	16.435
Story1	3.2	12.771
Base	0	0

6. CONCLUSIONS

- The findings indicate that the highest storey displacement is measured at the top storey of the Model-I without a Masonry infill structure, 80.107 mm in the Models-II & III of Masonry infill structure as strut eccentric back and eccentric forward as same displacement, and 64.857 mm in the Model-IV with masonry infill and X type of strut. The lowest displacement is measured at the first storey of each Model at 73.539 mm, 24.007 mm, 24.007 mm, and 11.459 mm, respectively, along the X direction. There is zero displacement at the base of the structure along the X direction.
- When comparing all the models, Model I's top storey displacement is 127.759 mm without an infill structure, while Model IV's Masonry infill structure with X type struts has a minimum storey displacement of 11.459 mm. This indicates that the ideal construction to provide the least amount of storey displacement is a masonry infill structure, particularly an X-type strut.
- The findings indicate that the highest storey displacement is detected at the top storey of Model-I without a Masonry infill structure, 188.238 mm in Model-II & Model-III of Masonry infill structure as strut eccentric back and eccentric forward as same displacement, and 98.898 mm in Model-IV with masonry infill with X type of strut. Meanwhile, the lowest displacement is found at the first storey of each Model, 26.708 mm, and 12.771 mm, respectively, and there is zero displacement at the base of the structure along the Y direction.
- When comparing all the models, the Model-I structure with no infill structure has the largest displacement at the top storey of 188.238 mm, while the Model-IV structure with a Masonry infill structure of X kind of Strut has the smallest storey displacement of 98.898 mm. This indicates that the ideal construction to provide the least amount of storey displacement is a masonry infill structure, particularly an X-type strut.

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