

A Comparative Analysis and Design for G+24 Storey Tall Concrete Building with Shear Wall Frame Structure and Tube Structure System

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Abstract- In India, due to urbanization there are considerable increases in the construction of tall building. Different lateral load resisting system in high rise building is adopted such as tubular frame structure, shear wall system, moment resisting frame system to resist lateral load such as wind, earth quake and blast load.

Keeping in view, A G+24 storey RCC tall building in analysis and design with shear wall frame structure considering different positions and optimum percentage of shear wall giving least values is considered and tube structure system in Etabs software. Using code IS 16700:2017 “Criteria for structural safety of tall concrete buildings”.

Seismic calculations are conducted for two cases zone III and zone V and structure response due to lateral load on moment, axial force, shear force, base shear, maximum storey drift, story displacement are evaluated. Lastly quantity of material will be prepared considering the cost of building.

Key words- Tall Concrete Building, Tube Structure System and Shear wall with frame structure system.

I. INTRODUCTION

1 TALL BUILDING

Tall concrete framed buildings will almost always rely on the lift and stair core for a large proportion of their lateral stability and overturning capacity. Structural engineers need to pay particular attention to the position, size and arrangement of the core. Centrally located cores are preferred but are not an absolute requirement. Positioning the core too far from the centre of a building plan may necessitate the use of other lateral stability systems to resist building twist.

2 FRAME STRUCTURE WITH SHEAR WALL

RC shear walls are designed for buildings located in seismic areas, because of their high strength, stiffness and high ductility.

3 TUBE FRAME STRUCTURE

Conceptually, this system is based on a hollow tube, with the large distance between the tension and compression elements in both directions serving to resist lateral forces. The structural principle is based on the flange of the tube frame being perpendicular to lateral wind forces, tied at each end by the webs of the framed tube which are oriented parallel to the wind.

II. LITERATURE REMARK

- Changing the position of shear wall will affect the attraction of forces, so that wall must be in proper position.
- We observed that base shear increases in the model with shear wall when compared to the model without shear wall. This is due to increase in stiffness of building.
- The reduction of displacement of storey is due to increase in stiffness of structure.
- Shear walls and braces improved the seismic performance of frames.
- Combination of braces and shear walls in a specific arrangement containing shear walls in middle bay and braces in the outer bays was the most effective arrangement for lateral load resistance in the elastic range.
- The Framed Tube is very much effective in resisting lateral loads (both Wind and Earthquake loads) compared to the Shear Wall Structures.

III. DESIGN OF MODEL

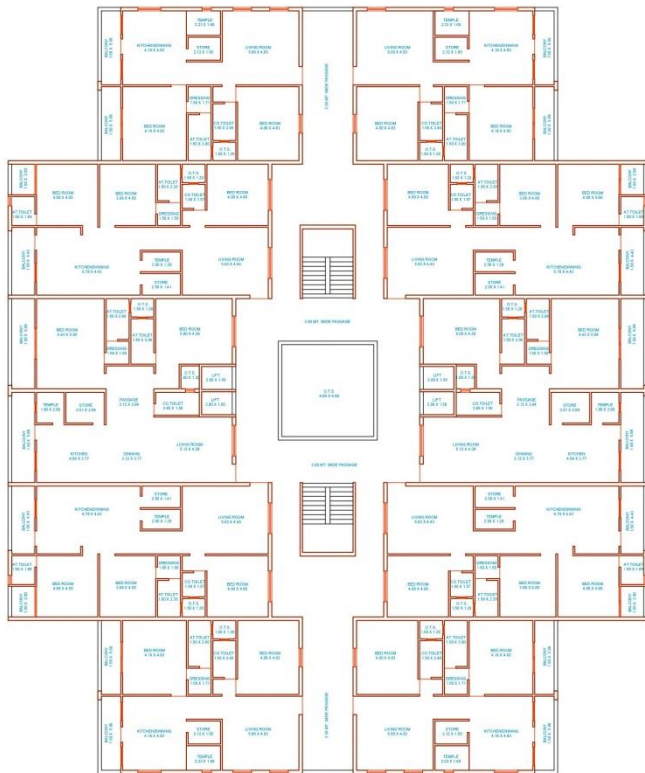


Figure- Typical Floor Plan

BARE FRAME STRUCTURE (ZONE III)

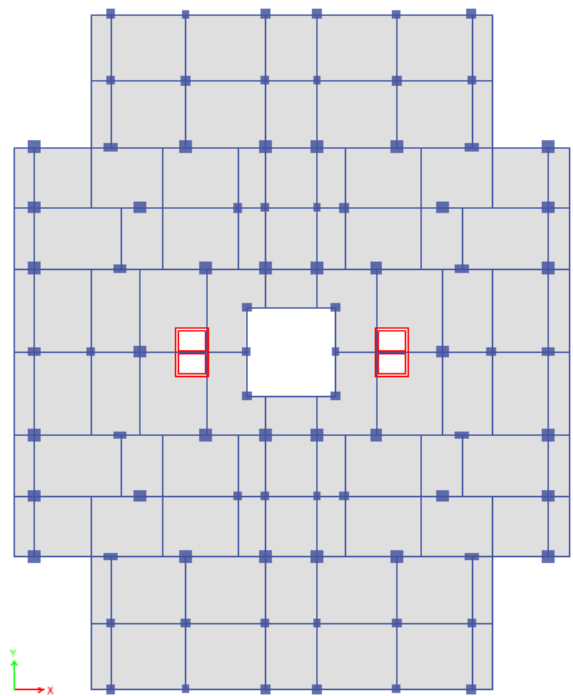


Figure - BARE FRAME STRUCTURE - PLAN

TYPES OF STRUCTURES

1. Bare frame structure
2. Frame structure with shear wall
3. Tube structure

DETAILS OF BUILDING

1. Dimension of building: 42.00 mt. X 50.00 mt.
2. G+24 Storey
3. Floor Hieght 3.00 mt.
4. Base Hieght 3.00 mt.
5. Residensial Building
6. 10 flats per each floor.
7. 04 nos. of lifts
8. 02 nos. of stair case

LOCATION OF BUILDING

1. Ahemdabad (Zone III)
2. Bhuj (Zone V)

SEISMIC DESIGN DATA (ZONE III)

1. Seismic Zone : III. (AHEMDABAD)
2. Zone factor (Z) : 0.16.
3. Soil type : Medium soil.
4. Damping ratio : 5%.
5. Response reduction factor (R): 5.
6. Importance factor (I) : 1.

SEISMIC DESIGN DATA (ZONE V)

1. Seismic Zone : V. (BHUIJ)
2. Zone factor (Z) : 0.36.
3. Soil type : Medium soil.
4. Damping ratio : 5%.
5. Response reduction factor (R): 5.
6. Importance factor (I) : 1.

Table - Bare Frame Structure's Elements Details

S.R. NO.	ELEMENT NAME	SECTION SIZE	CONCRETE GRADE
01	BEAM	230 X 400 mm	M30
02	BEAM	300 X 500 mm	M30
03	BEAM	300 X 600 mm	M30
04	BEAM	450 X 700 mm	M30
05	COLUMN	600 X 600 mm	M40
06	COLUMN	700 X 700 mm	M40
07	COLUMN	900 X 900 mm	M40
08	COLUMN	600 X1000 mm	M40
09	SLAB	150mm Thic.	M25
10	LIFT WALL	180mm Thic.	M25

SHEAR WALL FRAME STRUCTURE (ZONE III)

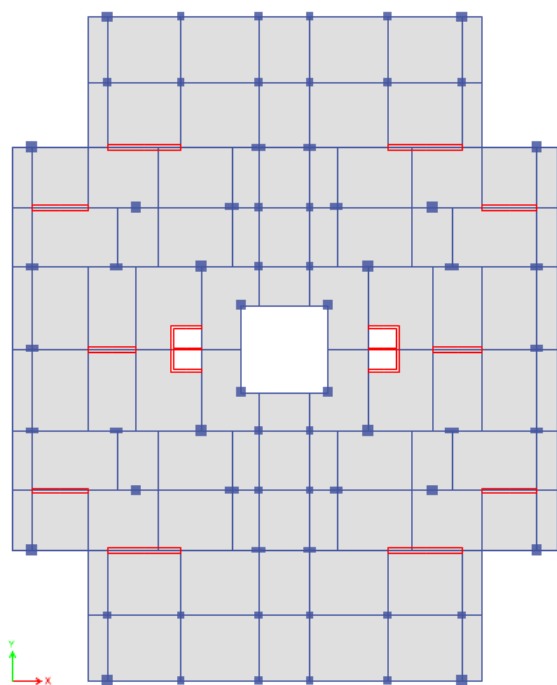


Figure - SHEAR WALL FRAME STRUCTURE - PLAN

Table - Shear Wall Frame Structure's Elements Details

S.R. NO.	ELEMENT NAME	SECTION SIZE	CONCRETE GRADE
1	BEAM	230 X 400 mm	M30
2	BEAM	300 X 500 mm	M30
3	BEAM	300 X 600 mm	M30
4	BEAM	350 X 700 mm	M30
5	BEAM	400 X 800 mm	M30
6	COLUMN	600 X 600 mm	M40
7	COLUMN	800 X 800 mm	M40
8	COLUMN	500 X 1100 mm	M40
9	SLAB	150 mm Thic.	M25
10	LIFT WALL	180 mm Thic.	M25
11	SHEAR WALL	400 mm Thic.	M25

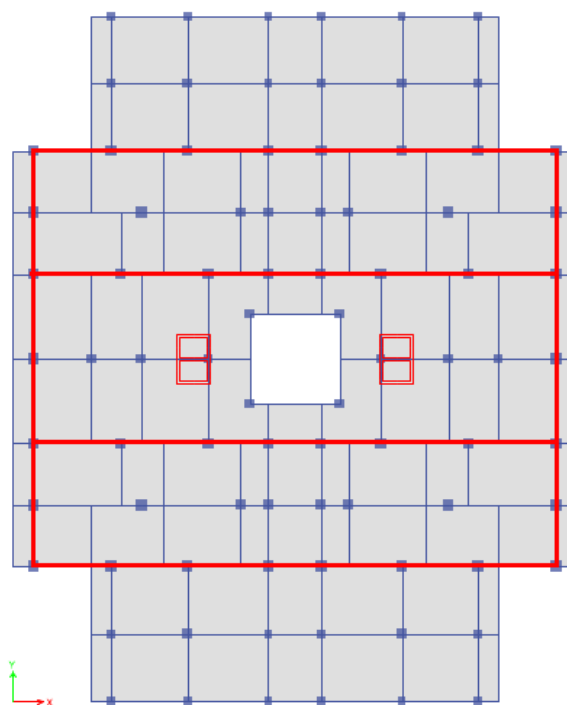


Figure - TUBE STRUCTURE - PLAN

Table - Tube Structure's Elements Details

S.R. NO.	ELEMENT NAME	SECTION SIZE	CONCRETE GRADE
1	BEAM	230 X 400 mm	M30
2	BEAM	300 X 600 mm	M30
3	BEAM	350 X 700 mm	M30
4	COLUMN	600 X 600 mm	M40
5	COLUMN	700 X 700 mm	M40
6	COLUMN	800 X 800 mm	M40
7	SLAB	150 mm Thic.	M25
8	LIFT WALL	180 mm Thic.	M25

BARE FRAME STRUCTURE (ZONE V)

TUBE STRUCTURE (ZONE III)

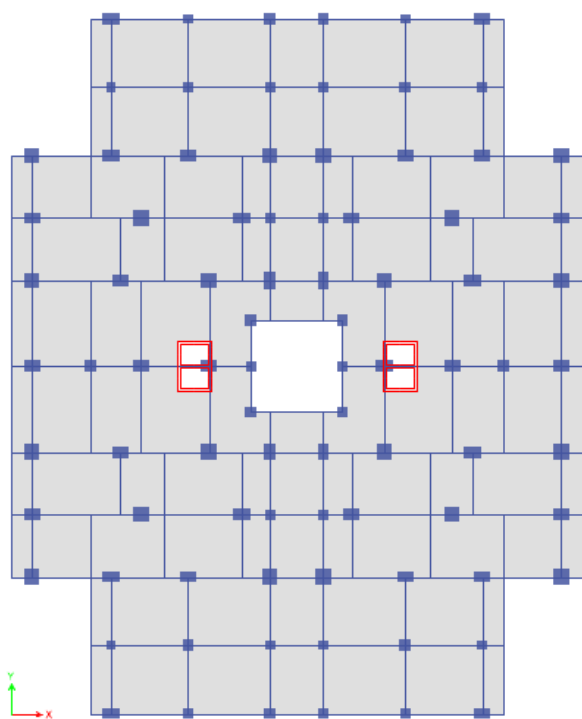


Figure - BARE FRAME STRUCTURE - PLAN

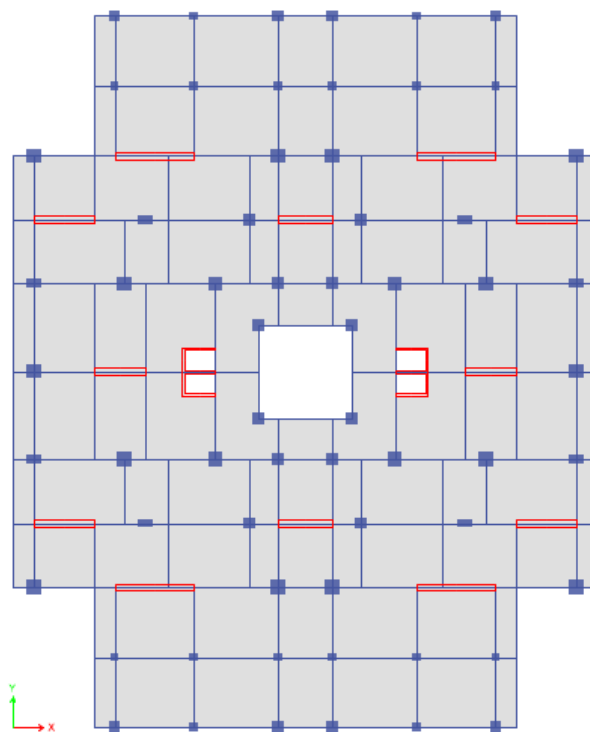


Figure - SHEAR WALL FRAME STRUCTURE - PLAN

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S.R. NO.	ELEMENT NAME	SECTION SIZE	CONCRETE GRADE
01	BEAM	230 X 400 mm	M30
02	BEAM	230 X 500 mm	M30
03	BEAM	400 X 800 mm	M30
04	BEAM	600 X 900 mm	M30
05	COLUMN	700 X 700 mm	M40
06	COLUMN	800 X 800 mm	M40
07	COLUMN	1100 X 1100 mm	M40
08	COLUMN	800 X 1200 mm	M40
09	SLAB	150 mm Thic.	M30
10	LIFT WALL	180 mm Thic.	M25

SHEAR WALL FRAME STRUCTURE (ZONE V)

Table - Shear Wall Frame Structure's Elements Details

S.R. NO.	ELEMENT NAME	SECTION SIZE	CONCRETE GRADE
01	BEAM	230 X 400 mm	M30
02	BEAM	300 X 600 mm	M30
03	BEAM	600 X 800 mm	M30
04	COLUMN	600 X 600 mm	M40
05	COLUMN	800 X 800 mm	M40
06	COLUMN	1000 X 1000 mm	M40
07	SLAB	150 mm Thic.	M30
08	LIFT WALL	180 mm Thic.	M25
09	SHEAR WALL	400 mm Thic.	M25

TUBE STRUCTURE (ZONE V)

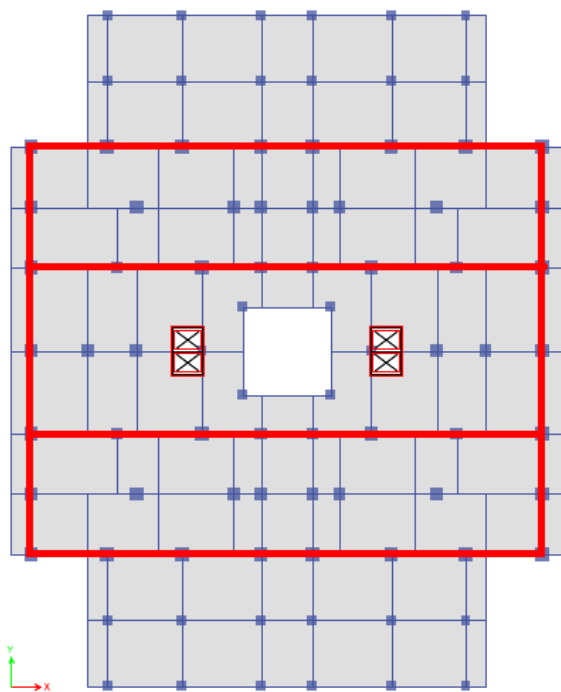


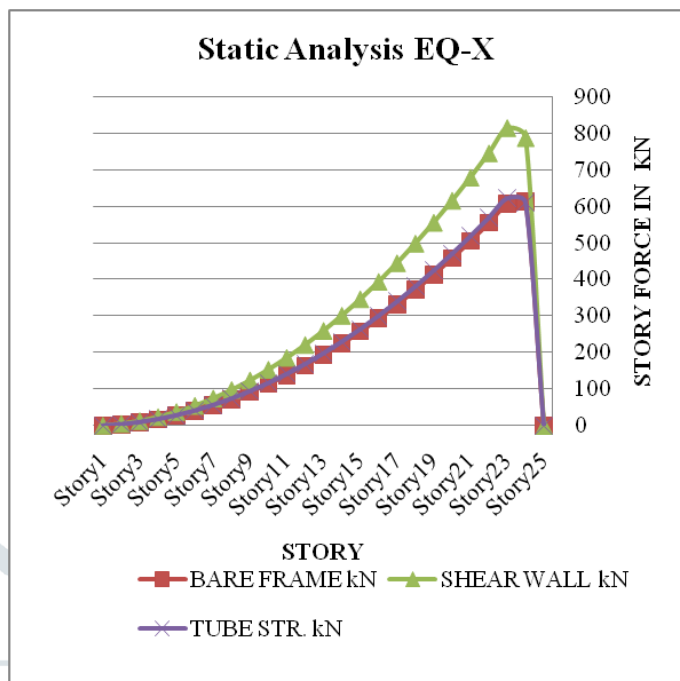
Figure - TUBE STRUCTURE - PLAN

Table - Tube Structure's Elements Details

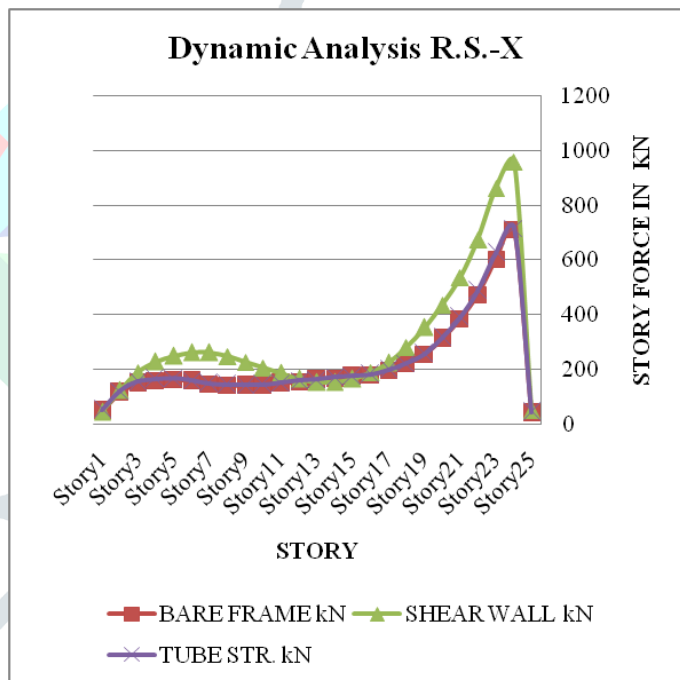
S.R. NO.	ELEMENT NAME	SECTION SIZE	CONCRETE GRADE
1	BEAM	230 X 400 mm	M30
2	BEAM	350 X 600 mm	M30
3	BEAM	500 X 900 mm	M30
4	COLUMN	700 X 700 mm	M40
5	COLUMN	900 X 900 mm	M40
6	COLUMN	1000 X 1000 mm	M40
7	SLAB	150 mm Thic.	M30
8	LIFT WALL	180 mm Thic.	M25

IV. RESULTS FOR ZONE V

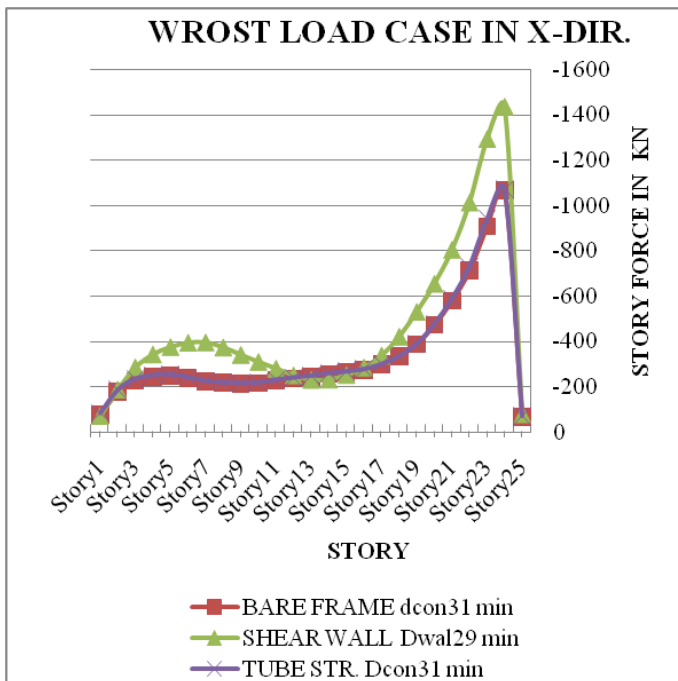
1. STORY FORCES RESULT FOR ZONE - III



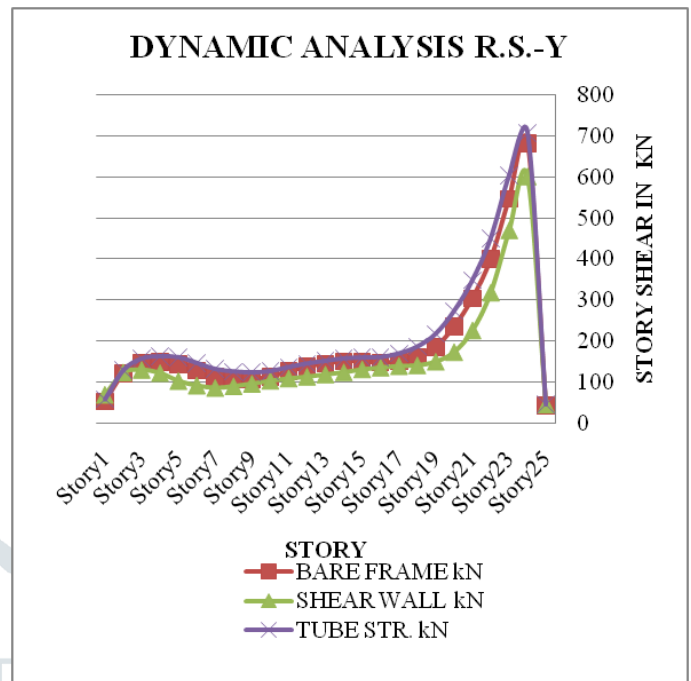
Static analysis Result for EQ-X



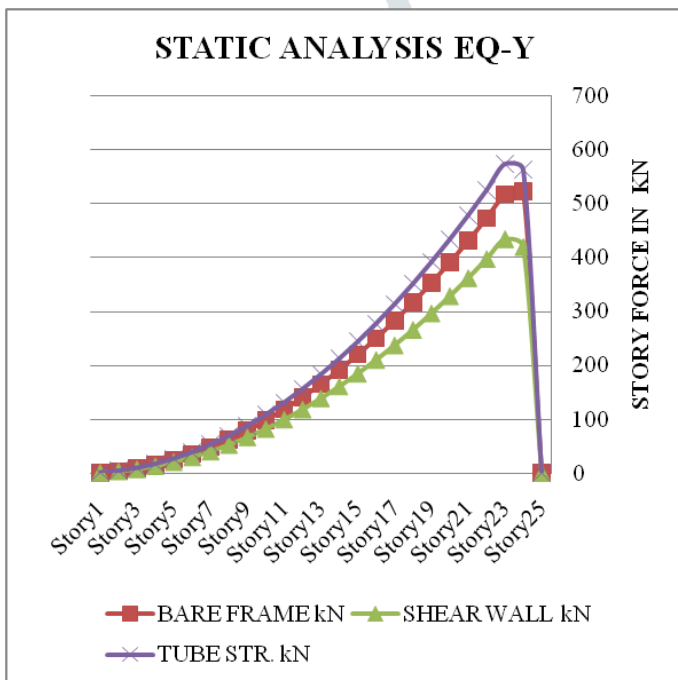
Dynamic analysis Result for R.S.-X



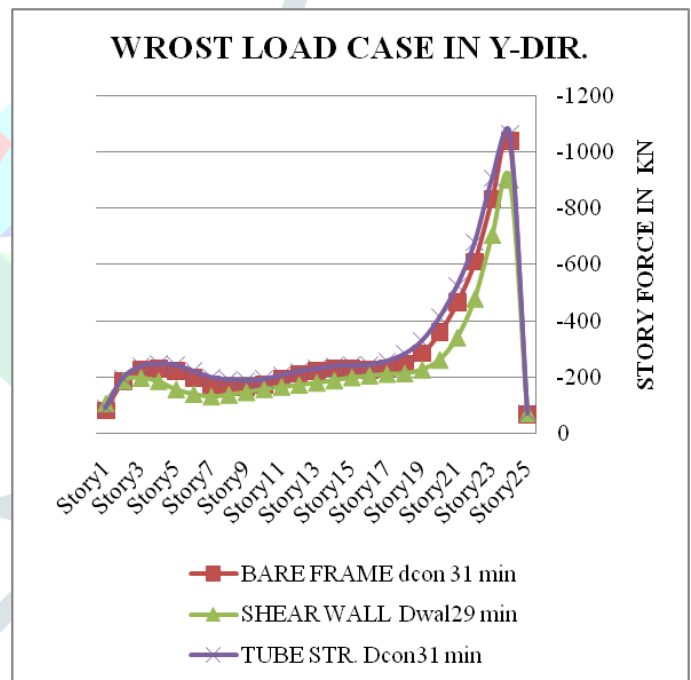
Worst Load Case for X - Direction



Dynamic Analysis for R.S. - Y

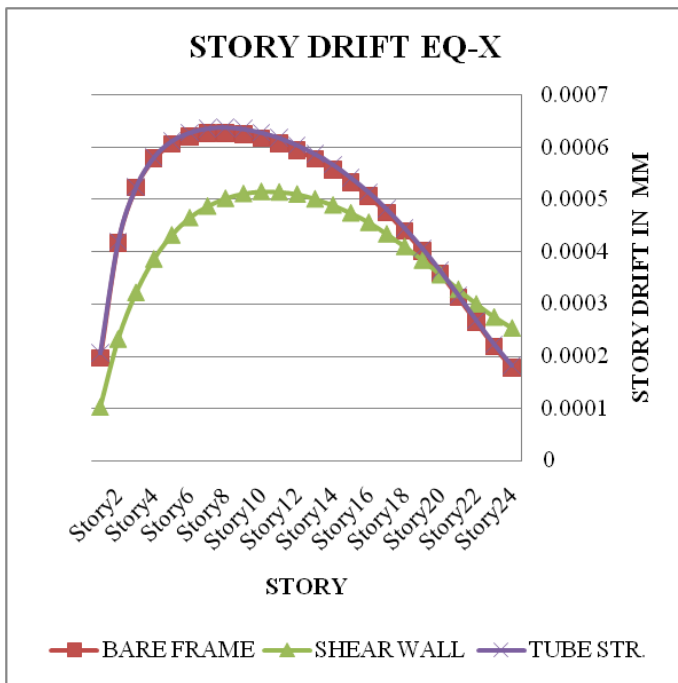


Static Analysis for EQ - Y Direction

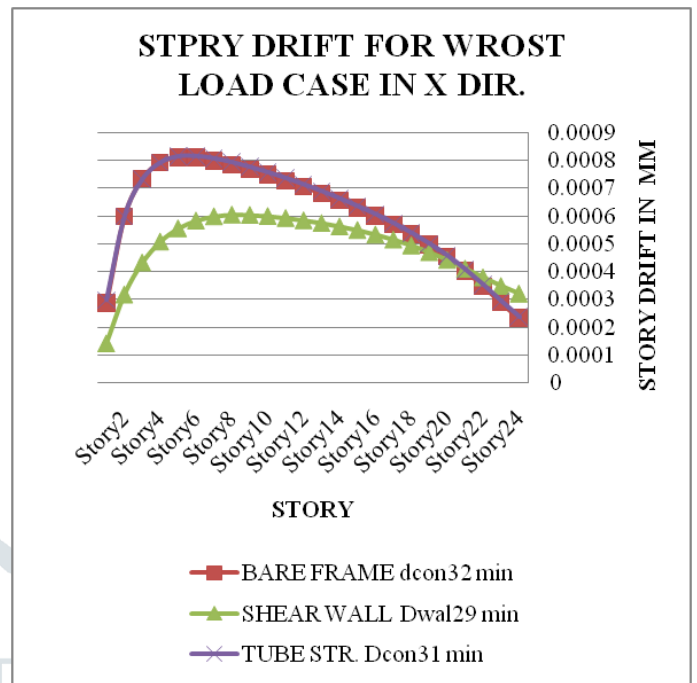


Worst Load Case In Y Direction

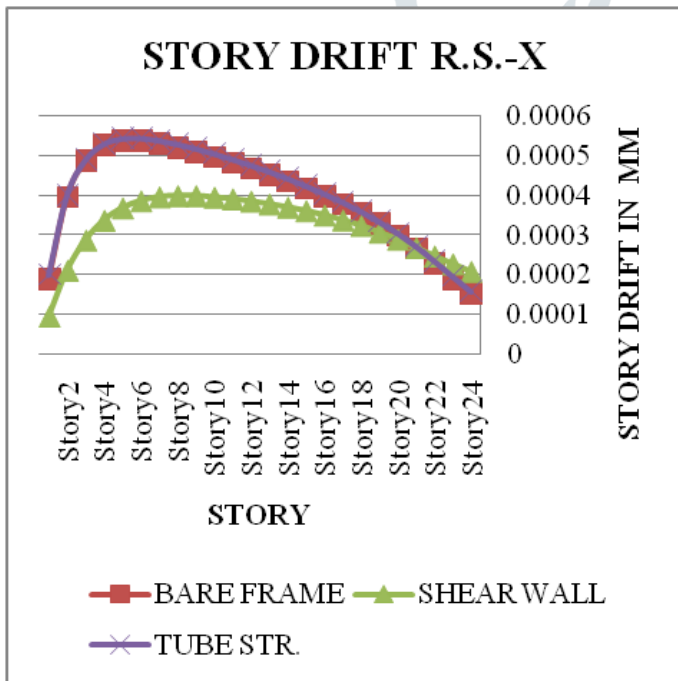
2. STORY DRIFT RESULT FOR ZONE - III



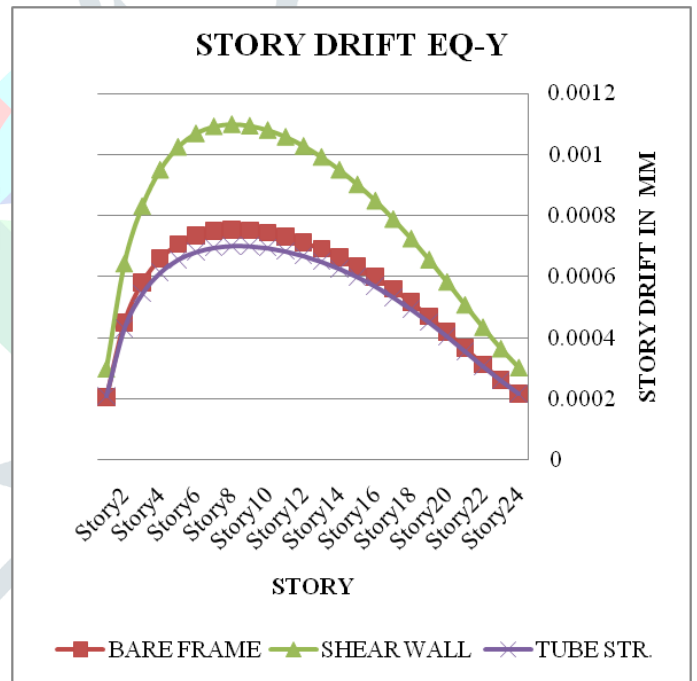
Story Drift for EQ - X.



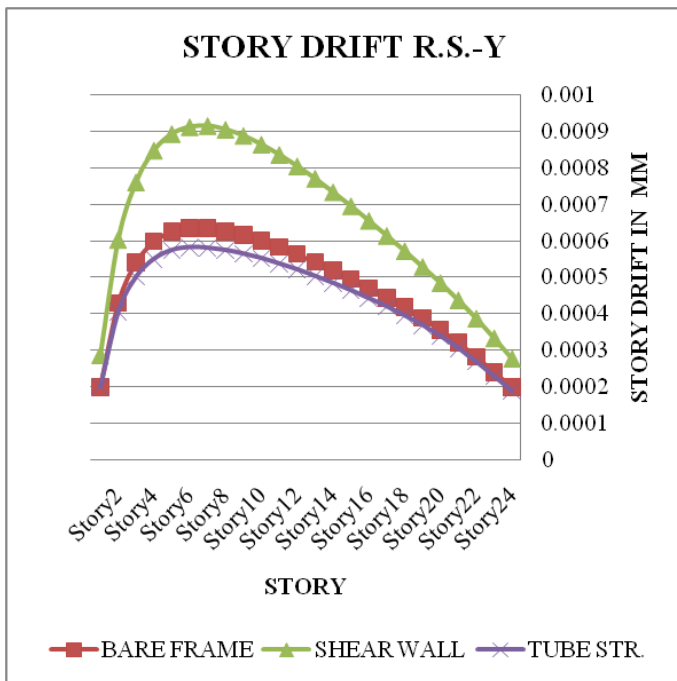
Story Drift for Worst Load Case In X Direction.



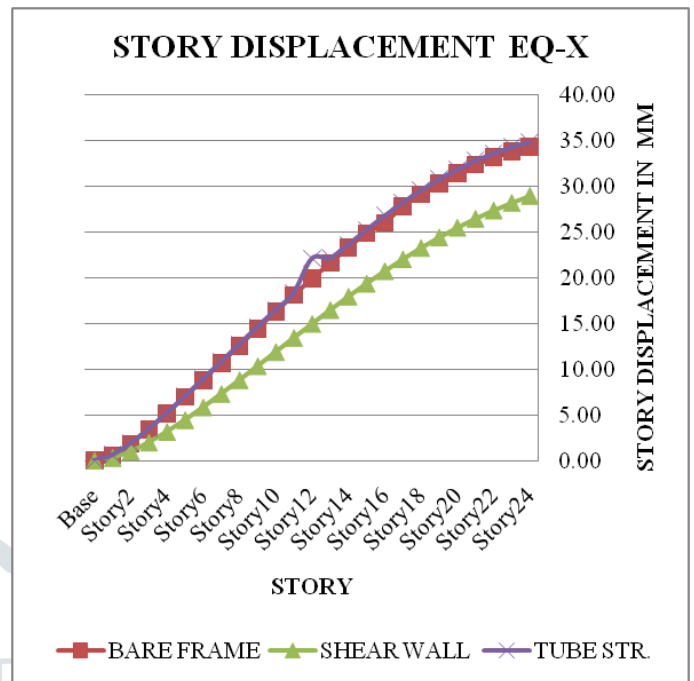
Story Drift for R.S. - X



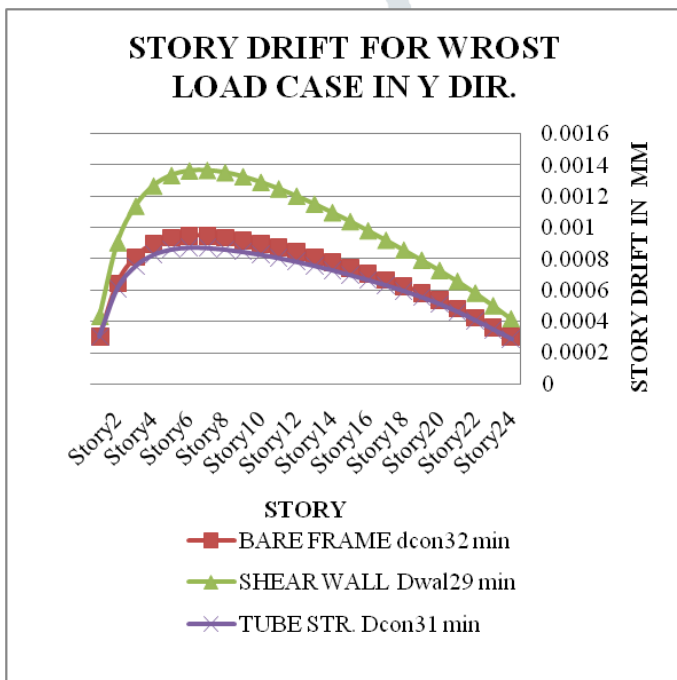
Story Drift EQ - Y



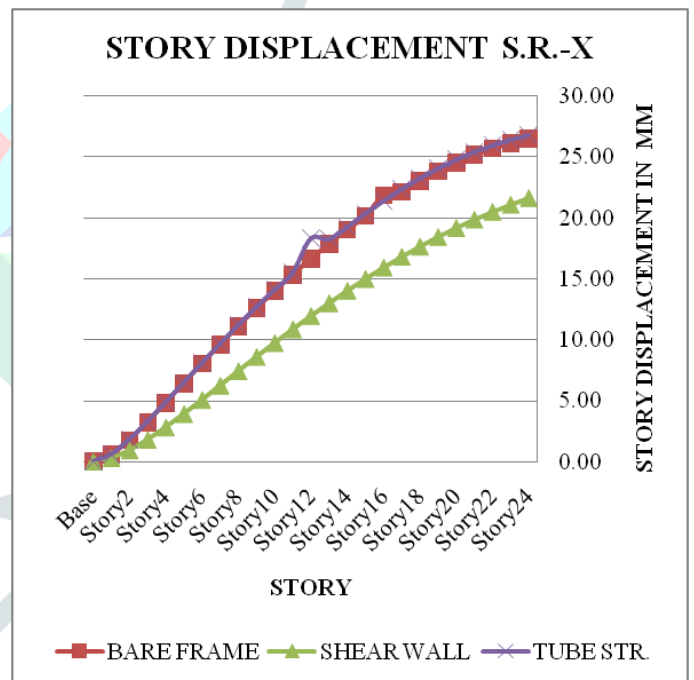
Story Drift R.S. - Y



Story Displacement for EQ - X.

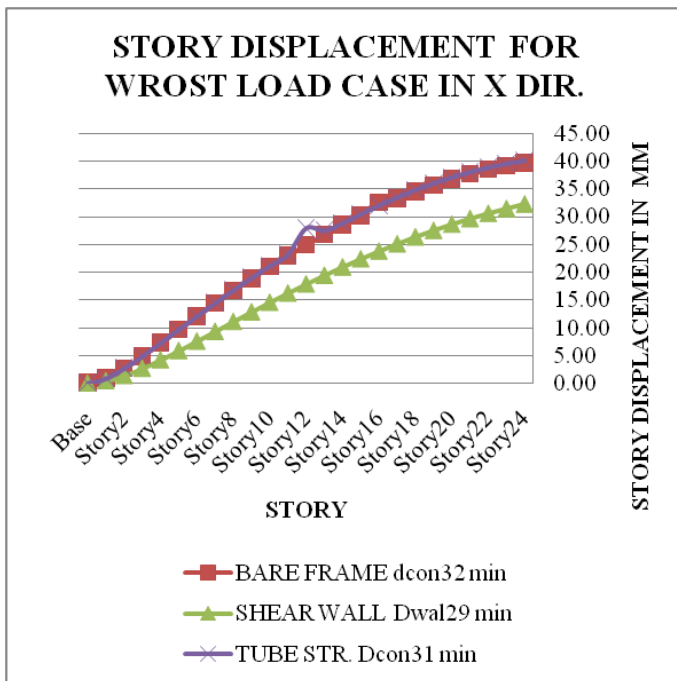


Story Drift for Worst Load Case in Y Direction

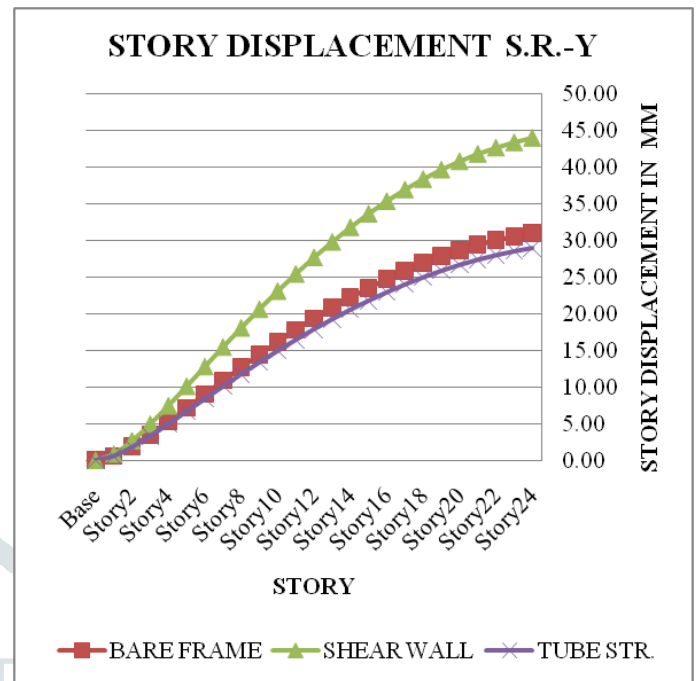


Story Displacement for R.S. - X.

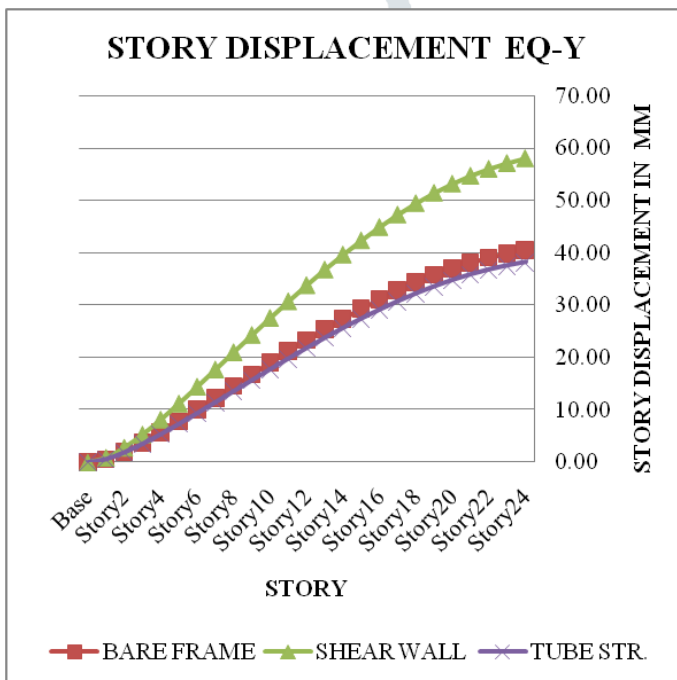
3. STORY DISPLACEMENT FOR ZONE - III



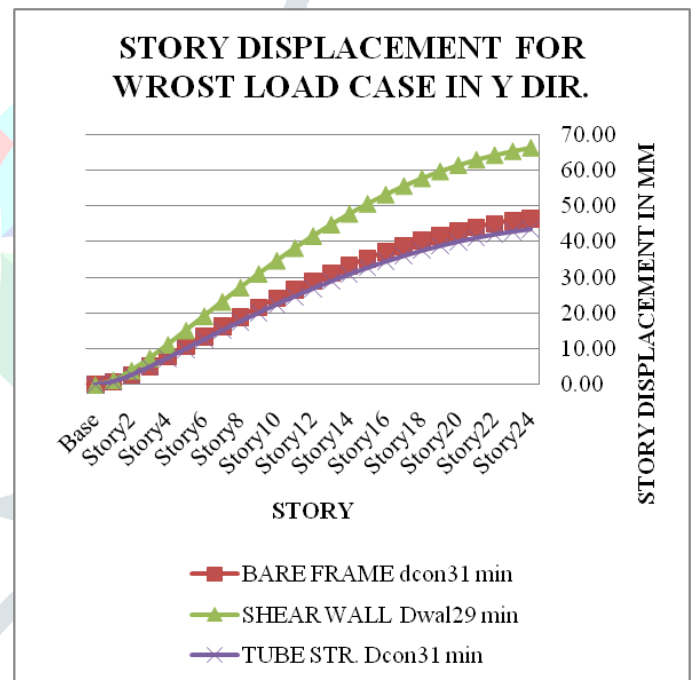
Story Displacement For Worst Load Case In X Direction



Story Displacement S.R.-Y



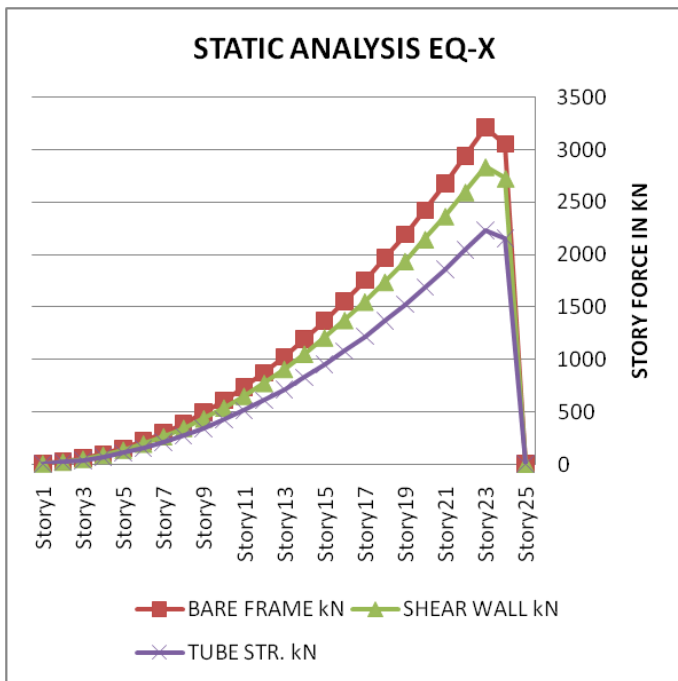
Story Displacement EQ-Y



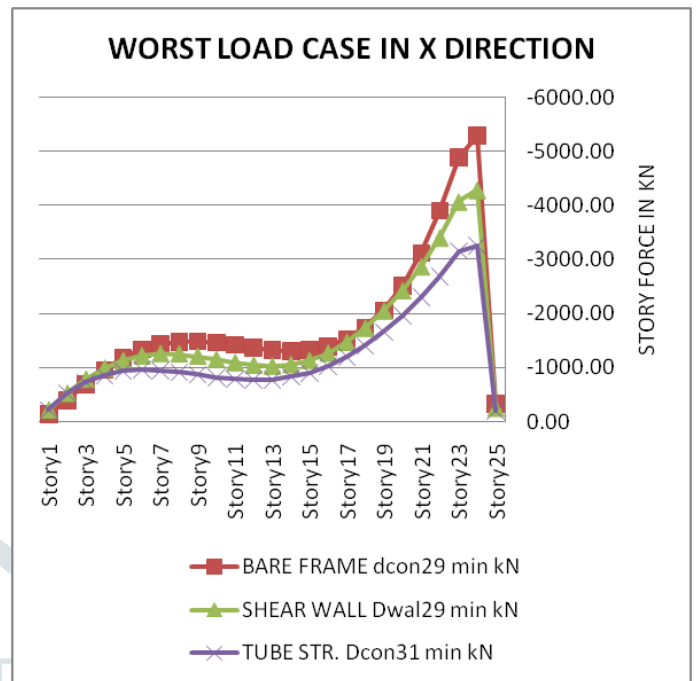
Story Displacement for Worst Load Case In Y Direction

IV. RESULTS FOR ZONE V

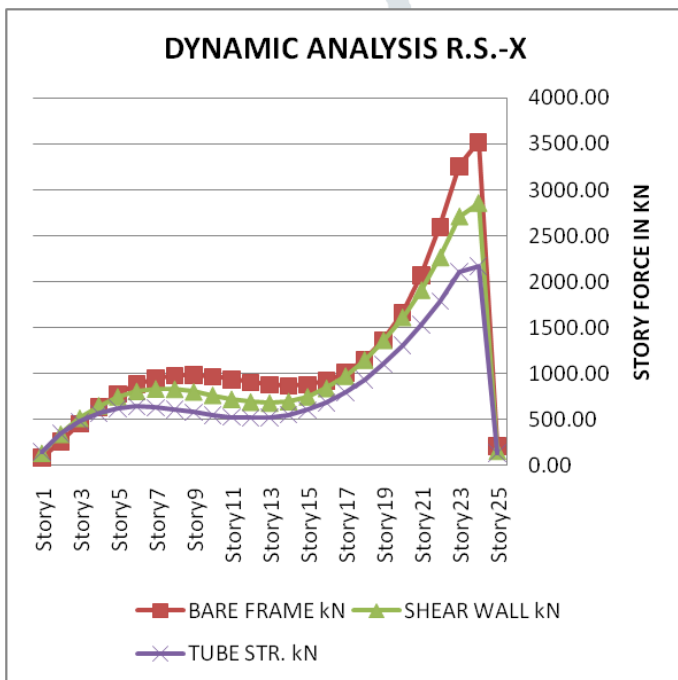
1. STORY FORCES RESULT FOR ZONE - V



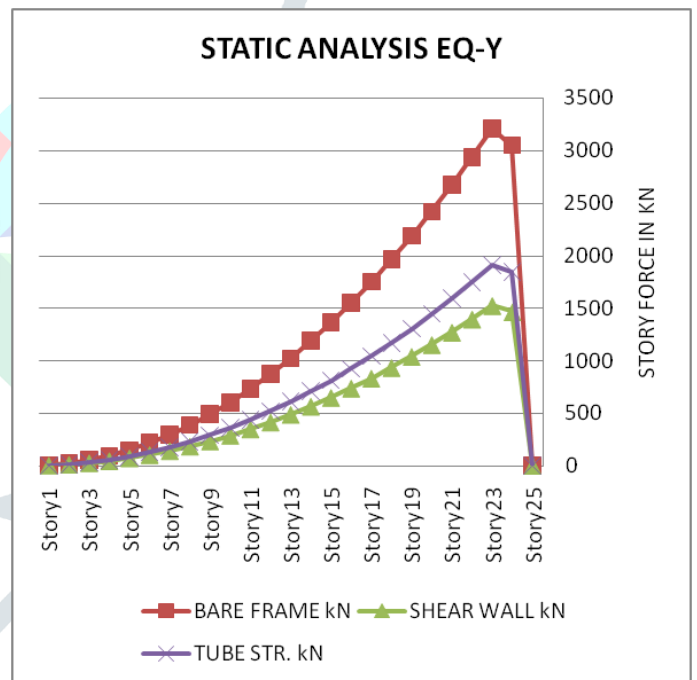
Static analysis Result for EQ-X



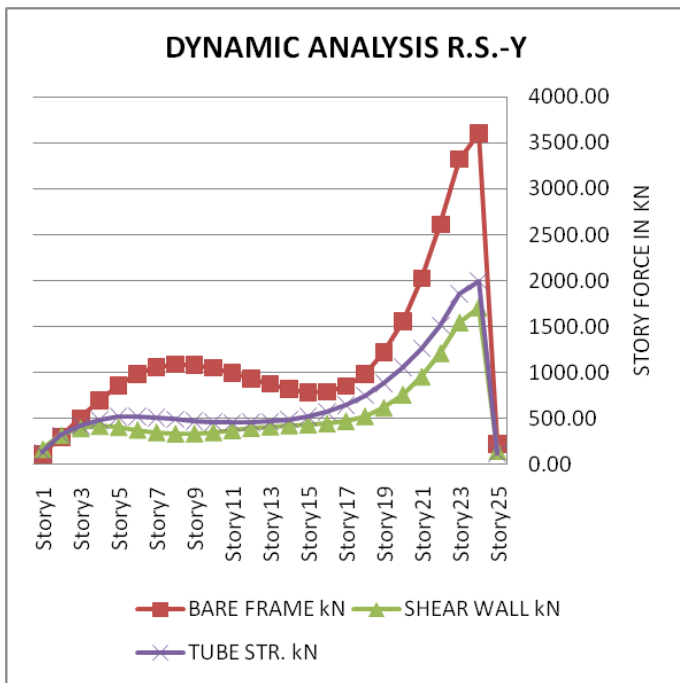
Worst Load Case In X Direction



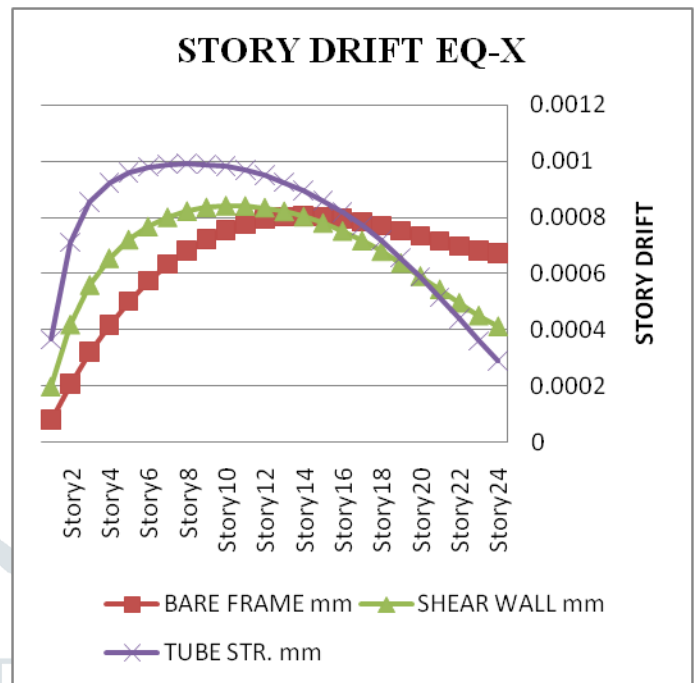
Dynamic analysis Result for R.S.-X



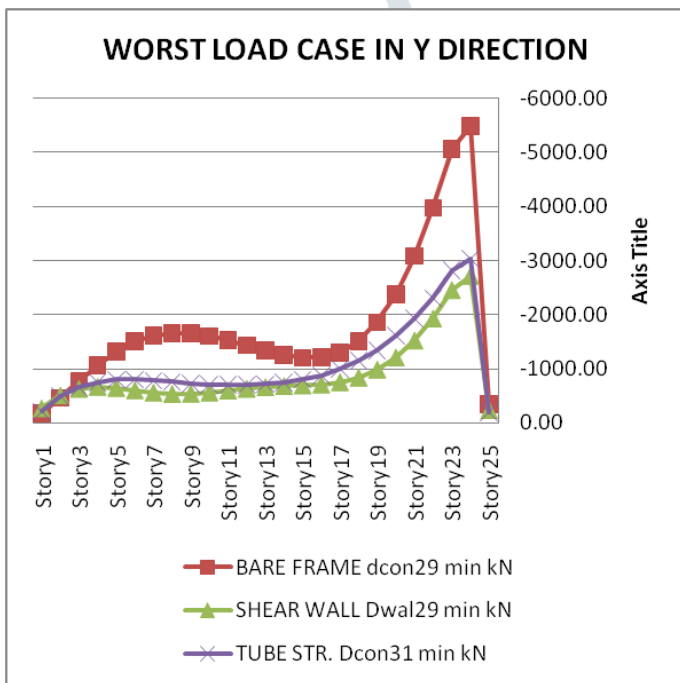
Static Analysis EQ-Y



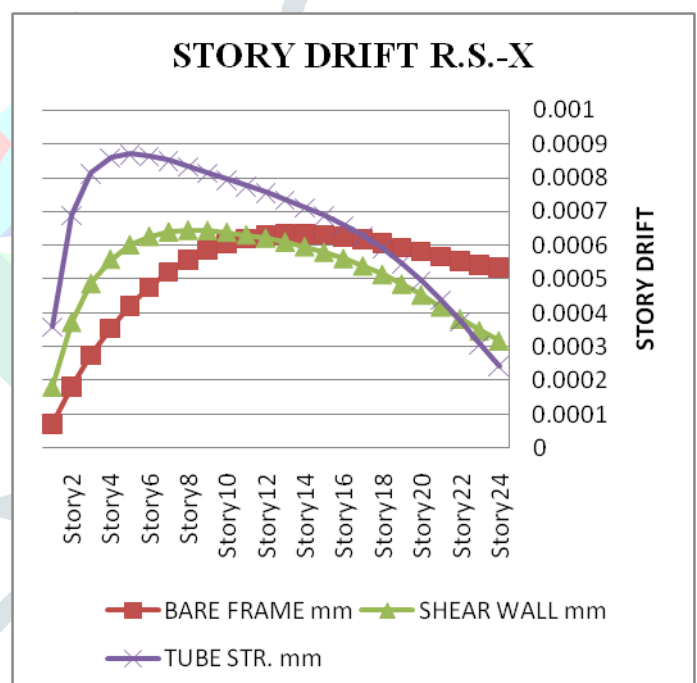
Dynamic Analysis R.S.-Y



Story Drift EQ-X

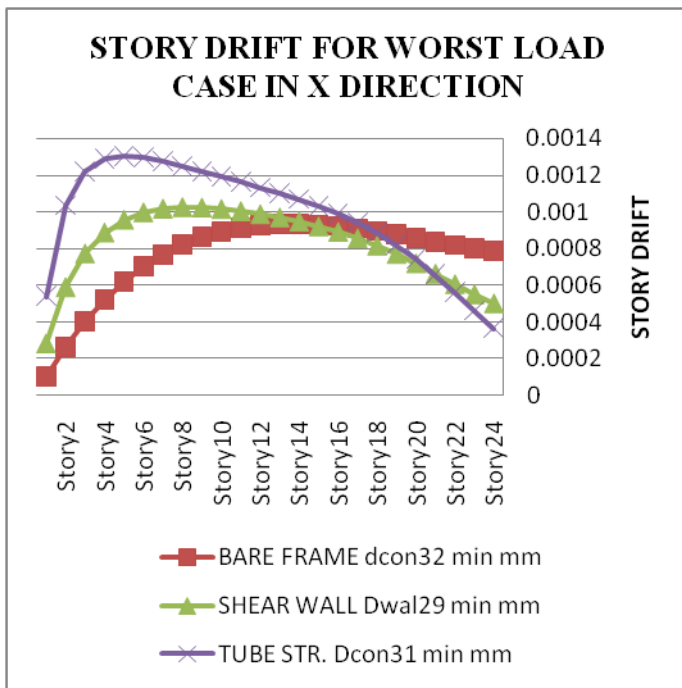


Worst Load Case In Y Direction

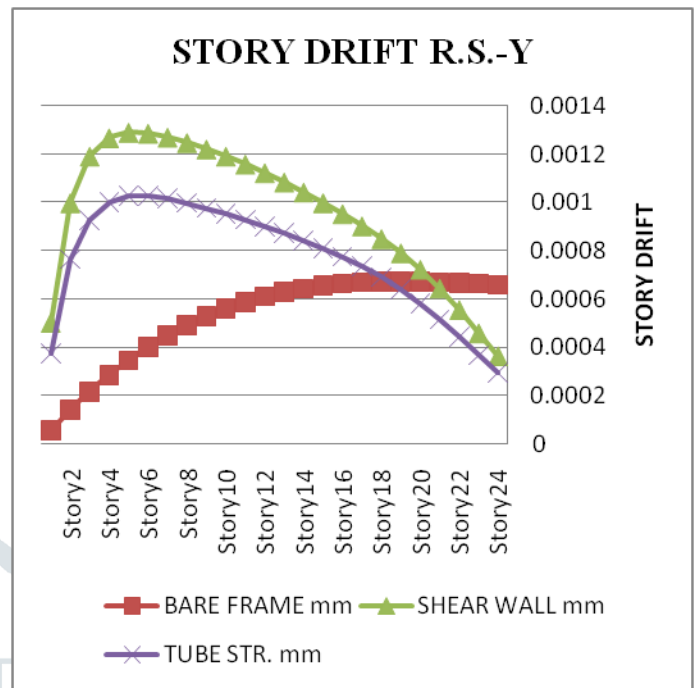


Story Drift R.S.-X

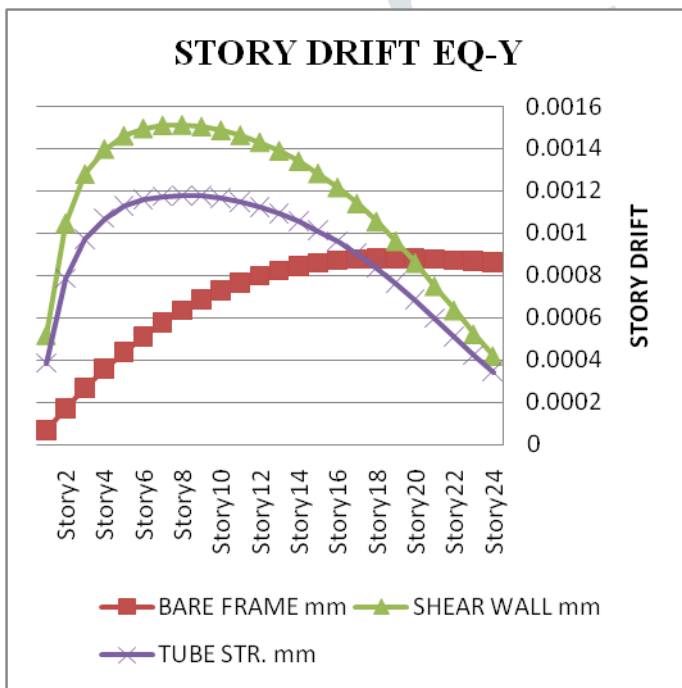
2. STORY DRIFT FOR ZONE - V



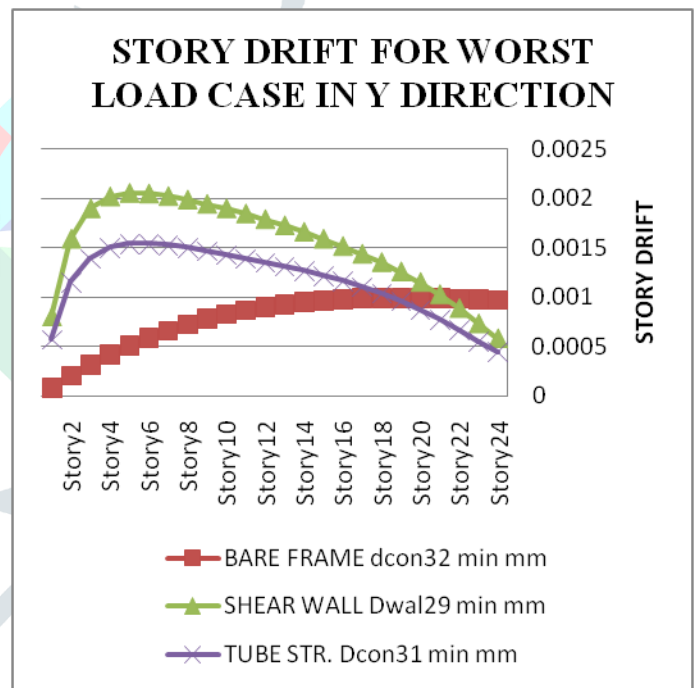
Story Drift For Worst Load Case In X Direction



Story Drift R.S.-Y

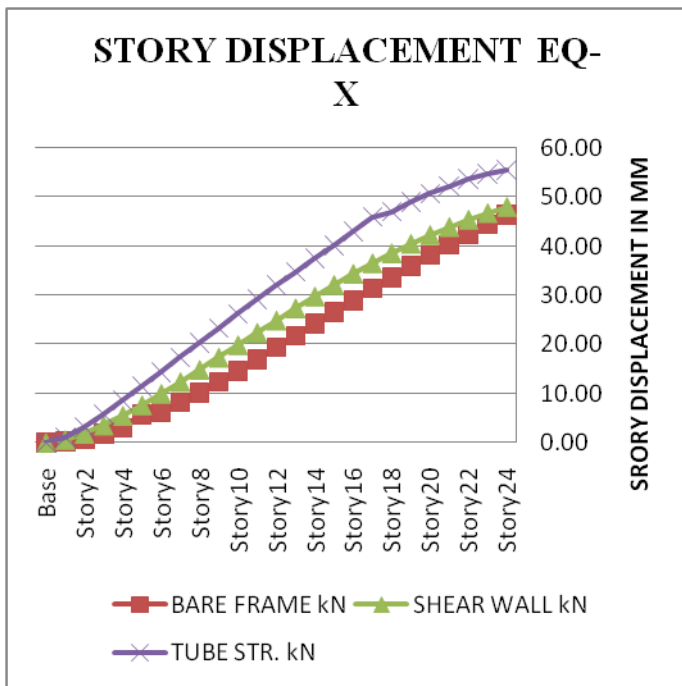


Story Drift EQ-Y

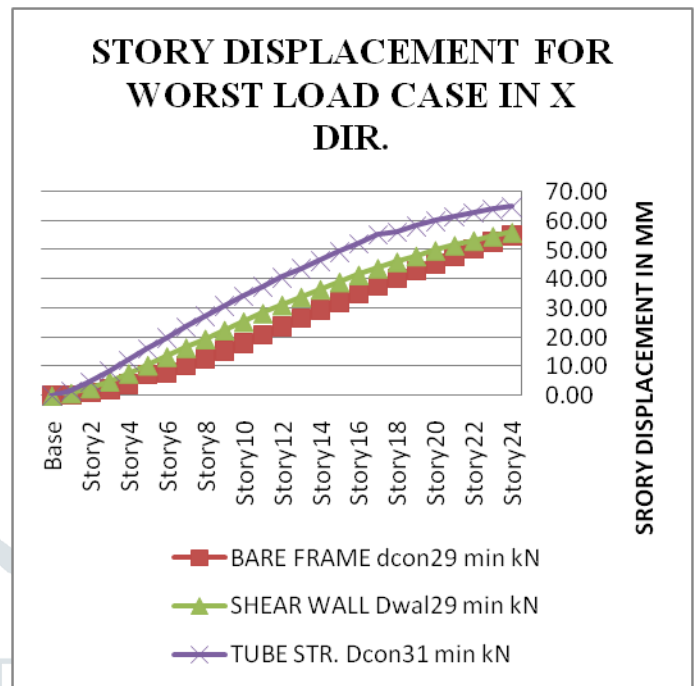


Story Drift for Worst Load Case In Y Direction

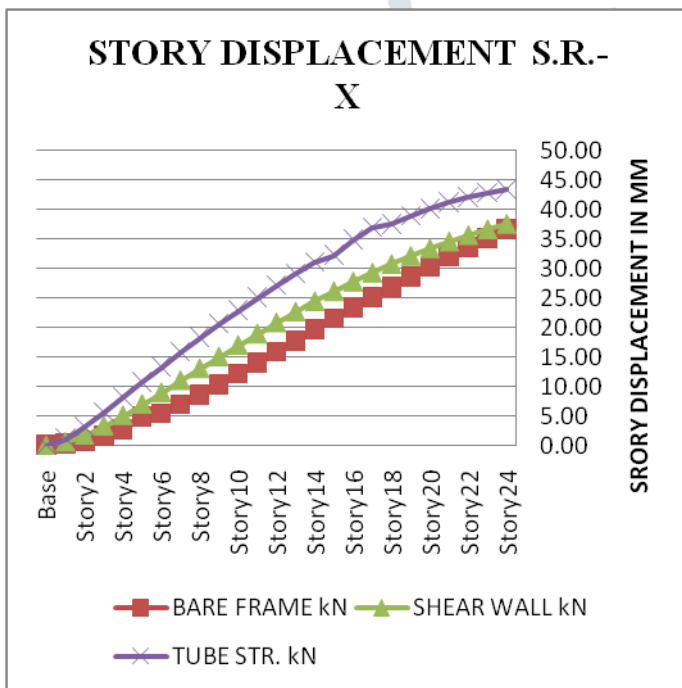
3. STORY DISPLACEMENT FOR ZONE - V



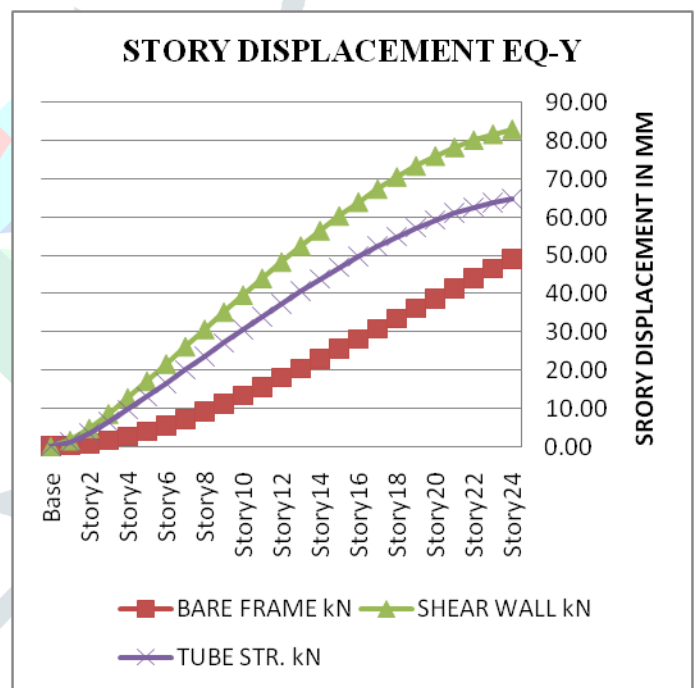
Story Displacement EQ-X



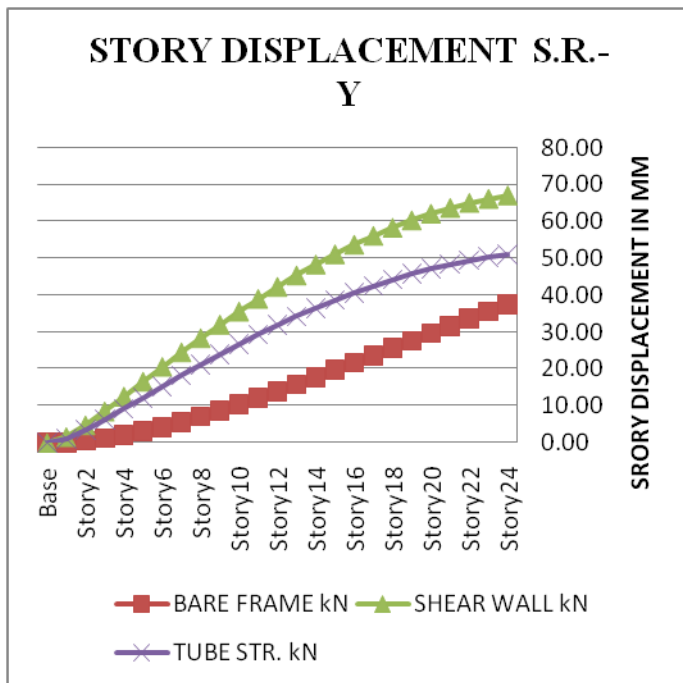
Story Displacement For Worst Load Case In X Dir.



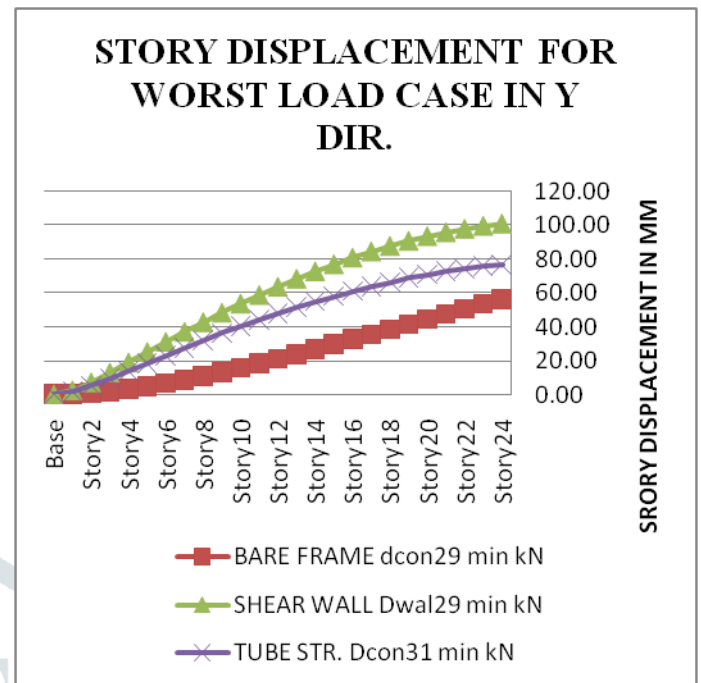
Story Displacement S.R.-X



Story Displacement EQ-Y



Story Displacement S.R.-Y



Story Displacement for Worst Load Case In Y Dir.

IV. CONCLUSION

- After the observing result that the behavior of building in the (G+24) story Bare Frame Structure, Shear wall Frame Structure and Tube Structure are very different.
- Story Displacement and story drift criteria satisfy in all type of structure.
- After estimating quantities of all type of structure it is observe that the tube structure is more economical compare to bare frame and shear wall frame structure.
- Shear wall structure is 3.0% more and bare frame structure is 2.25% costly compare to tube structure in zone III.
- Shear wall structure is 4.26% more and bare frame structure is 0.48% costly compare to tube structure in zone V.
- All three type of structure are behaving good in zone III compare to zone V.

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