TO STUDY THE STRUCTURAL BEHAVIOUR OF HIGH-RISE BUILDING USING RCC BELT

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Abstract : The belt wall selected one of the most proficient frameworks used to control the lateral load which is caused by earthquake load and wind load. There is various concept have evolved over the years in developing efficient lateral load resisting system e.g. shear wall. The creation of the walls in the multi-story building structure development has long been predictable. When the walls are in a promising position in the building, then lateral load can be very effective to resist the earthquake and wind loads. Structures with reinforced concrete structures are effective to withstand the vertical and horizontal loads following up on them. The aim of this study to minimize the displacement by providing periphery RCC belt wall in different floor levels.

Key word: *Belt wall, E-tab, displacement (joint displacement), seismic load, bare frame, wind load.*

1. INTRODUCTION

Lateral load is very difficult work for high rise building. There are two type of horizontal loads that is earthquake load and wind load. There are various technique to resist the lateral load are rigid frame with haunch girder, tube system with widely spaced column, rigid frame, flat slab-frame with shear wall, shear wall, coupled shear walls, flat slab-frame system, core-support structure, shear wall-frame interaction, outrigger and belt wall. In even structure center of mass and center of rigidity is at the same location then there is negligible eccentricity and therefore rotation of floor is less, however if the structure is irregular then center of mass and center of rigidity shall be at different point and eccentricity may result in rotation of floor. The lateral load resisting system are:

1.1 Rigid Frame with Haunch Girders

The office buildings usually have a more depth at exterior column compare interior column. The taper depth of connection from column to beam is suggested as haunch. Haunch is generally connected at outer periphery of building to resist the lateral load caused by wind or earthquake.

1.2 Outrigger & Belt Wall System

Auxiliary framework in this technique comprises of a concrete base core which is associated with outer sections by generally unbending level components, for example, profound dividers of a couple of floors, normally known as Outrigger System. The focal found center with outriggers reaching out in different sides or it tends to be situated on single side of the structure. Outside (external) segments with one story or two story having profound dividers are alluded as belt divider framework which associates around the outskirts of building.

1.3 Tube System with Widely Spaced Columns

In building terminology term “tube” suggest a close spaced column with deep spandrel. Building with compacted plan tube action can be achieved by widely spaced columns interconnection with deep spandrels.

1.4 Rigid Frame

A rigid frame is characterized by the flexure of the beams, flexure of the columns and by the rotation of the joints. For office and commercial building, the rigid frame is not efficient, because of following reason. The number (N) of columns in a given frame is limited because of lease considerations. Depth of beam is often limited by the height of floor consideration.

1.4 Shear Wall

Shear wall are uniquely structured in structures that oppose flat powers brought about by winds, earthquakes, and so forth. Shear dividers are commonly unbending individuals, typically gave in tall structures, so as to maintain a strategic distance from the all out breakdown of elevated structures by seismic tremor and wind powers. Inflexibility, Strength and Endurance can be effectively accomplished in handy by shear divider. For better force opposition, area of shear dividers as conceivable as on the fringe of the structure and this ought to be put evenly in the arrangement.

2. METHODOLOGY

Many examination laborers have analyzed outrigger bracket and belt framework yet the investigations were bound to steel structures and outriggers were comprised of steel. In this examination RCC divider have been taken which are monolithic with two adjacent floors. This will result into a total box at a given floor which gave more torsional inflexibility at that point open support divider arrangement of outrigger. The impact of this framework was likewise considered in dinner tall structures where as in this investigation this has been taken into consideration for a medium to small high-rise structure. The examination has been done for respectably high structure without shear center and belt divider is given on the outskirts. Plan of 20 story high rise RCC building structure and optimization of wall is done by software E-Tabs. This model is

dissected for pivotal and sidelong loads and the outcomes are thought about. For streamlining of belt divider area belt divider is set in 5 distinct areas and the outcomes got for deflection.

2.1 Building Model

- 20 story (G+19) Commercial building
- Soil type medium
- Story height = 3
- Grid in X-Direction = 9
- Grid in Y-Direction = 9
- Spacing in X-Direction = 4m
- Spacing in Y-Direction = 4m

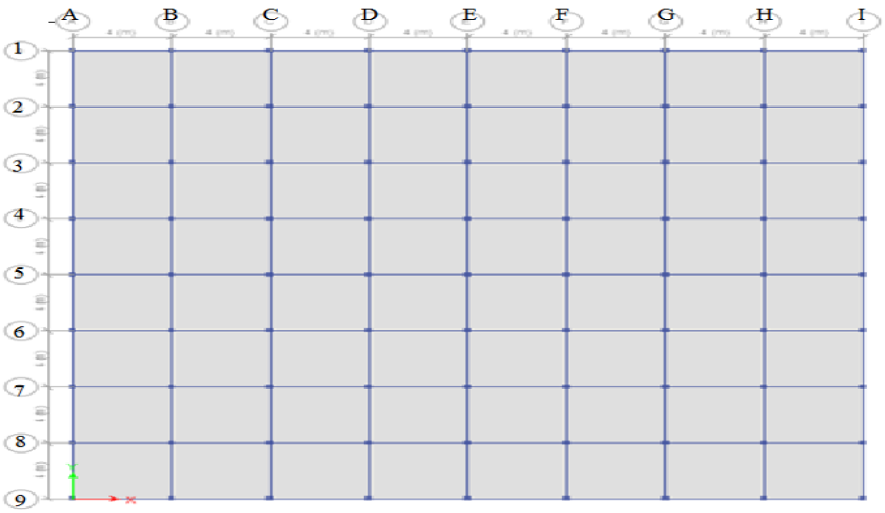
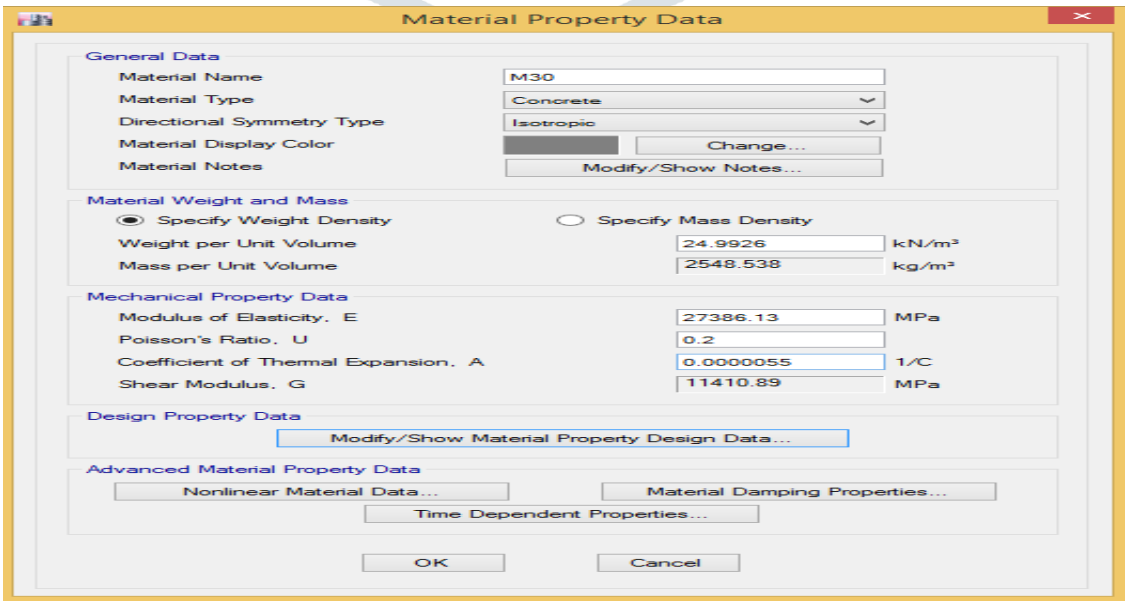
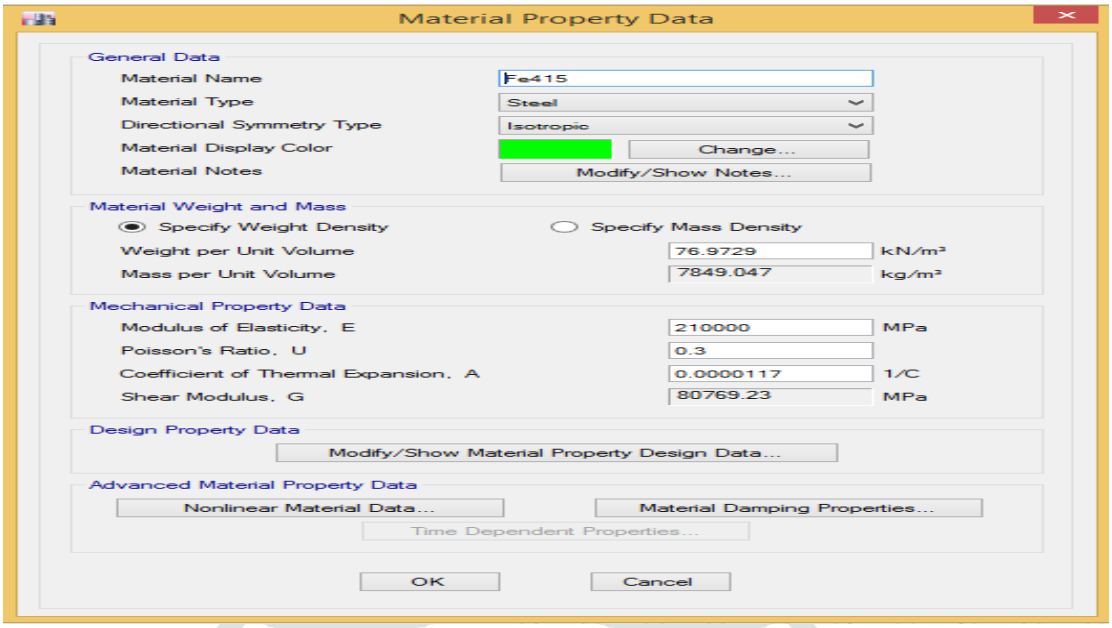


Fig. 3.2 Grid of Model

2.2 Define Material and Section

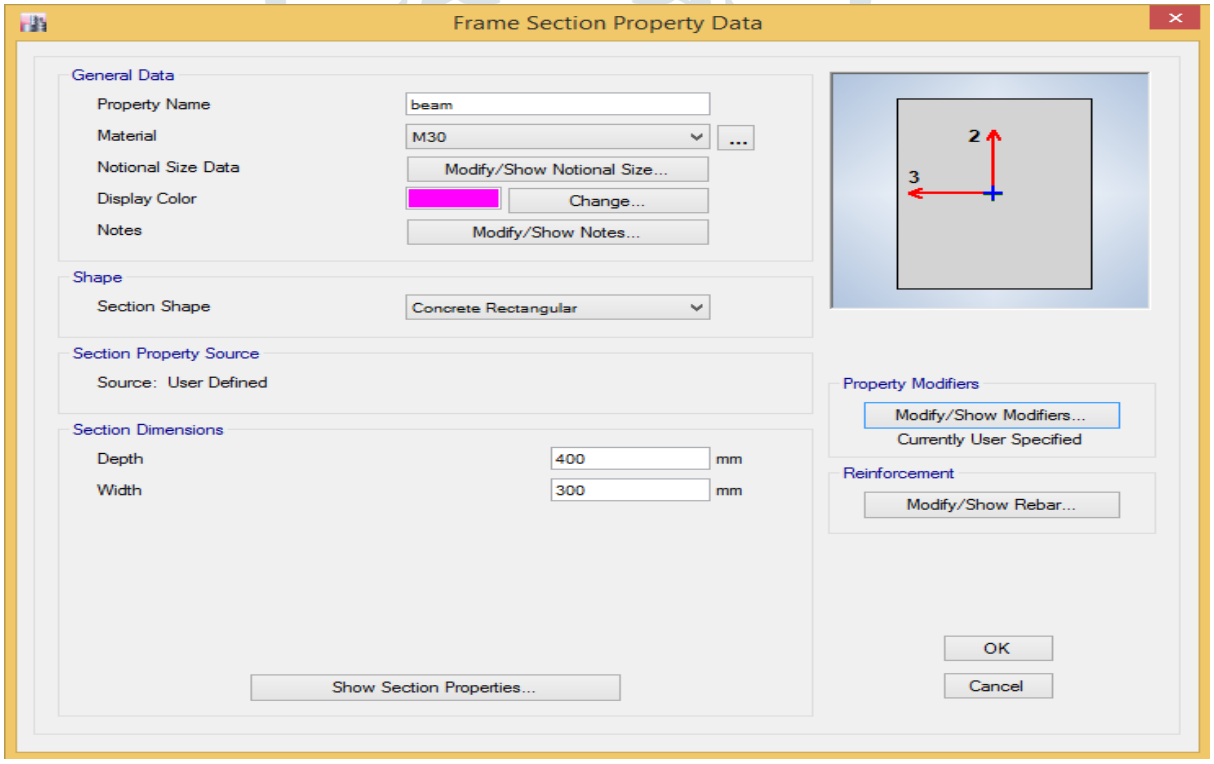
- Concrete M-30
- Steel fe-415





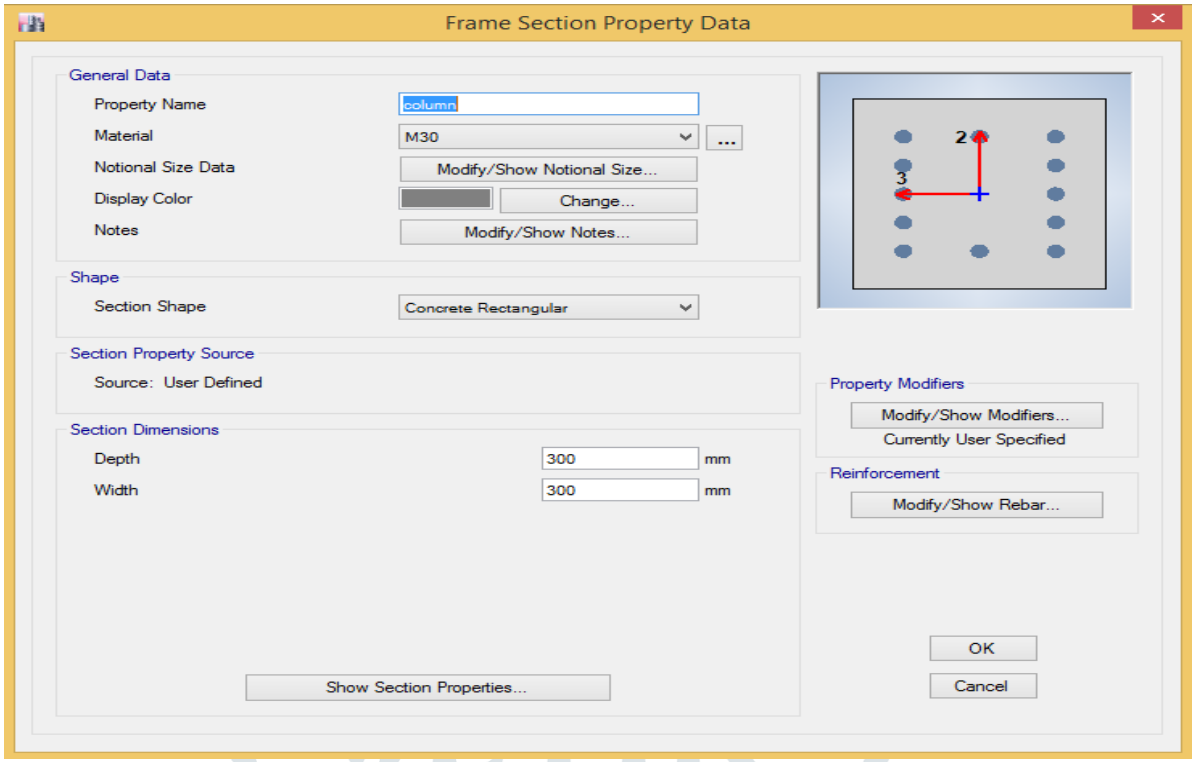
2.3 Beam

- Rectangular-300mm*400mm
- Cover-20mm



2.4 Column

- Rectangular- 300mmX300mm
- Cover- 40mm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General Data
Property Name
column
Material
M30
Notional Size Data
Modify/Show Notional Size...
Display Color
Change...
Notes
Modify/Show Notes...
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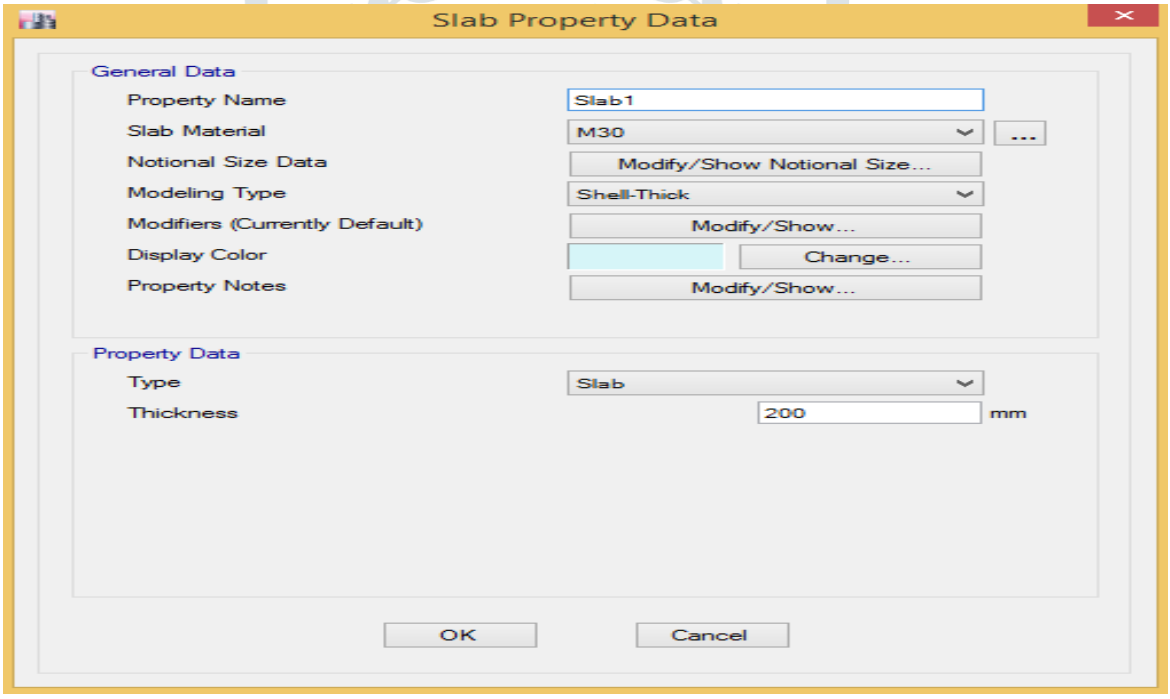
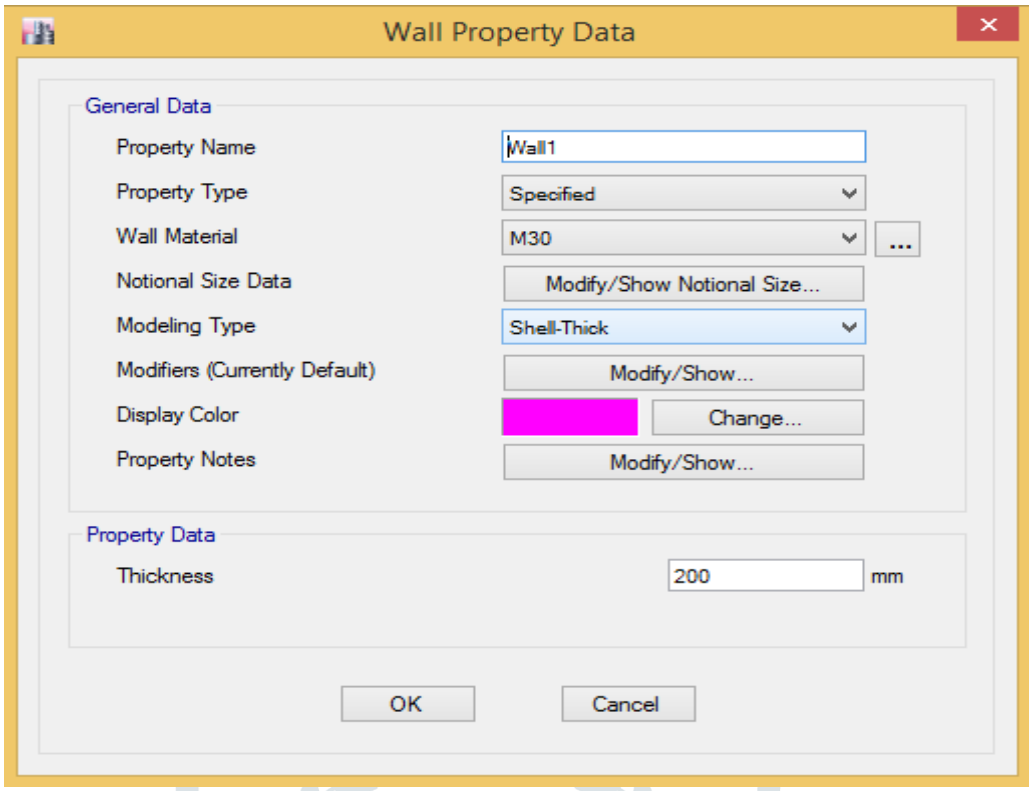
Section Shape
Concrete Rectangular
Section Property Source
Source: User Defined
Section Dimensions
Depth
300
mm
Width
300
mm
Show Section Properties...
Property Modifiers
Modify/Show Modifiers...
Currently User Specified
Reinforcement
Modify/Show Rebar...
OK
Cancel

2.5 Slab


Slab Property Data
General Data
Property Name
Slab1
Slab Material
M30
Notional Size Data
Modify/Show Notional Size...
Modeling Type
Shell-Thick
Modifiers (Currently Default)
Modify/Show...
Display Color
Change...
Property Notes
Modify/Show...
Property Data
Type
Slab
Thickness
200
mm
OK
Cancel

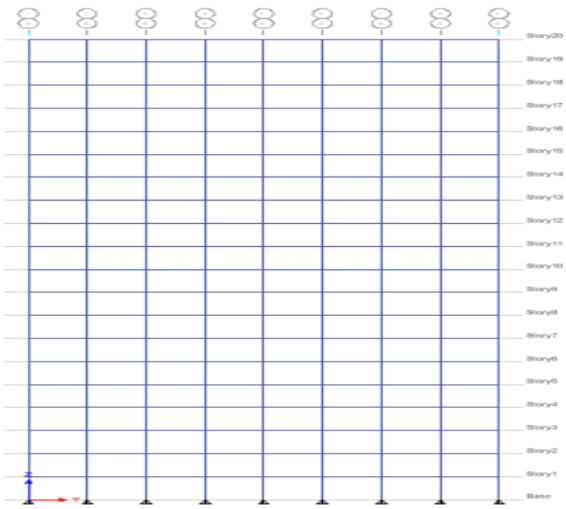
2.6 Wall



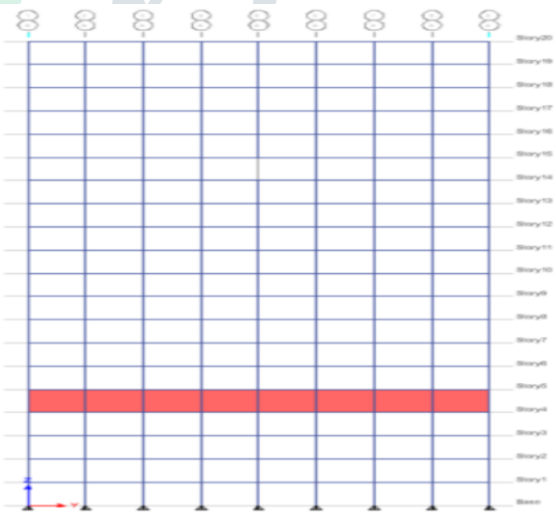
2.7 Define Load

(a) Dead Load (DL) as per IS 875 (Part 1) (1987)
(b) Live Load (LL) as per IS 875 (Part 2) (1987)
(c) Wind Load (WL) as per IS 875 (Part 3) (1987)
(d) Seismic load (EQL) as per IS 1893-2002 (Part 1)

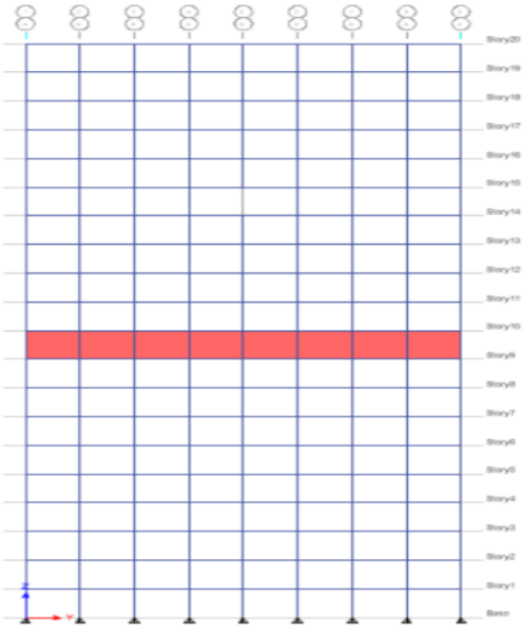
2.8 Different Rigidity Condition



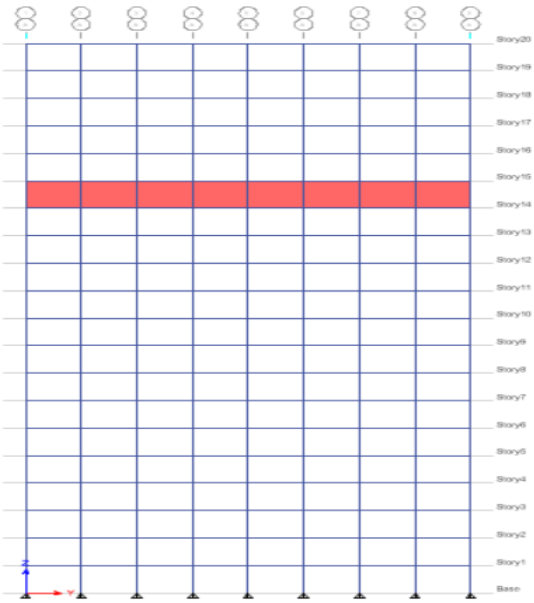
Bare Frame



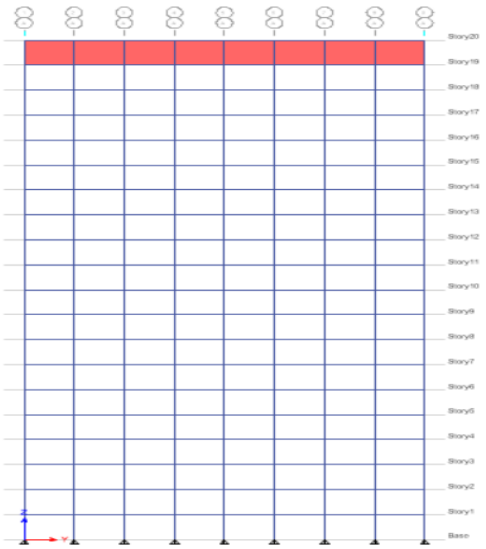
Wall at 5th Floor



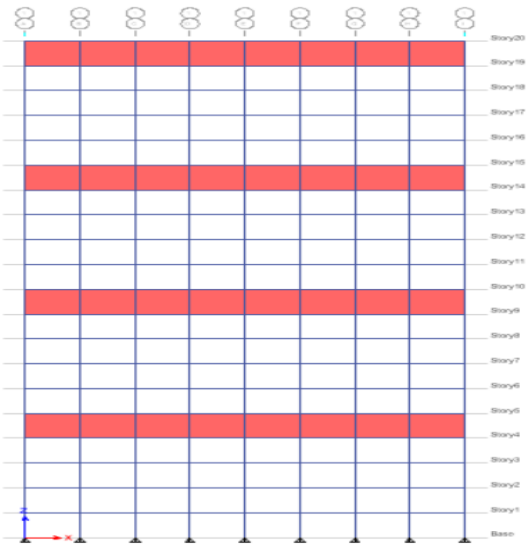
Wall at 10th floor



Wall at 15th floor



Wall at 20th floor



Wall at 5th,10th,15th,2th floor

Fig. 1 Different Rigidity Condition

3. RESULTS

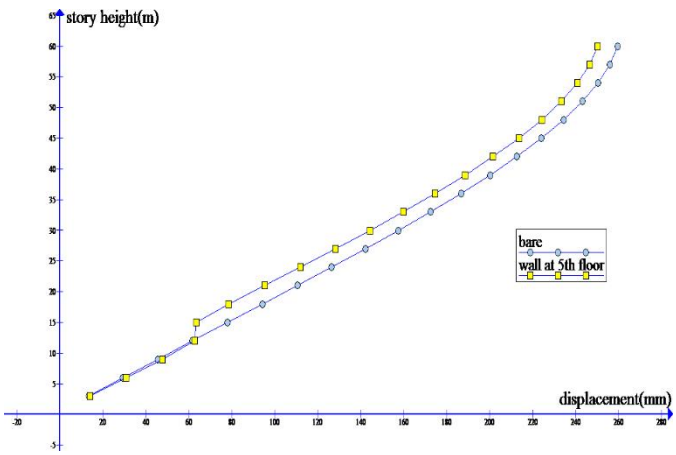
In this study comparison is being made with results obtained by providing belt wall at 5th, 10th, 15th, 20th & typical wall condition with bare frame for following values of displacement (joint displacement) on each floor.

3.1 Displacement Result (joint displacement)

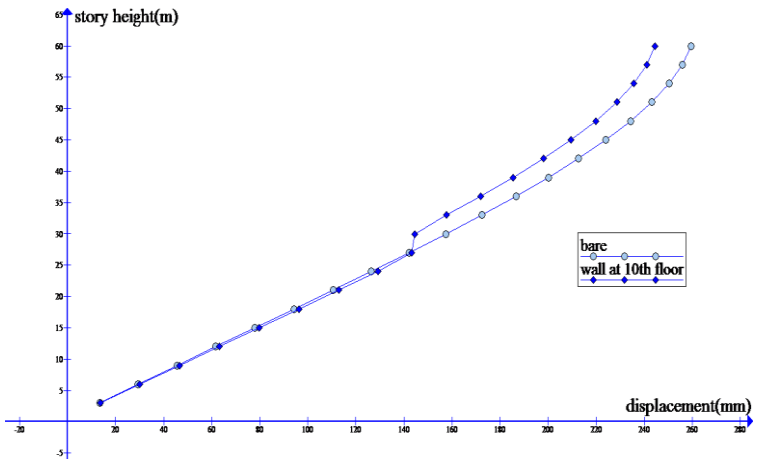
The displacement is maximum in X-direction compare to Y-direction and Z-direction because the earthquake load acting in X-direction. Then we study X-direction displacement result only. For each story all joint displacement result is approximate same. Then we study only one joint displacement result for one story. Displacement is found maximum in load combination 1.5(DL+EQ-X). Then we study only load combination 1.5(DL+EQ-X) for story displacement.

Table 4.2 Joint Displacement result comparison table

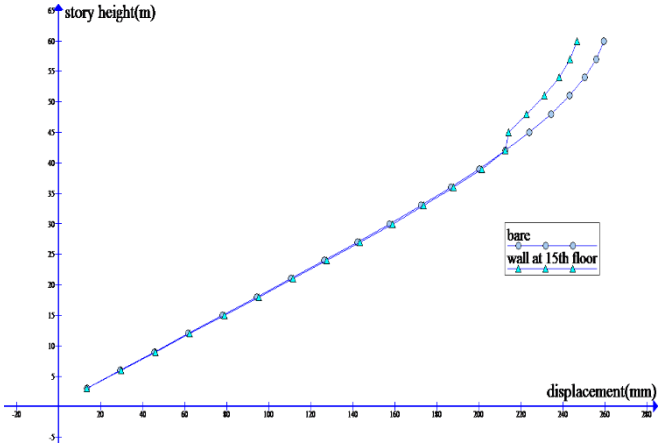
Story	Load case/Combo	Bare Frame mm	Belt Wall at 5th floor mm	Belt Wall at 10th floor mm	Belt Wall at 15th floor mm	Belt Wall at 20th floor mm	Belt Wall at 5th,10th,15th,20th floor mm	Z
Story 20	1.5(DL+EQ-X)	259.430	250.111	244.559	246.808	**260.300**	**228.85**	60
Story 19	1.5(DL+EQ-X)	255.883	246.488	241.134	234.526	259.007	227.621	57
Story 18	1.5(DL+EQ-X)	250.432	240.861	235.753	238.325	253.883	222.034	54
Story 17	1.5(DL+EQ-X)	243.182	233.352	228.547	231.349	246.883	214.123	51
Story 16	1.5(DL+EQ-X)	234.343	224.173	219.722	222.806	237.332	204.544	48
Story 15	1.5(DL+EQ-X)	224.092	213.517	209.467	**214.141**	226.868	**194.693**	45
Story 14	1.5(DL+EQ-X)	212.609	201.572	197.963	212.686	215.181	193.364	42
Story 13	1.5(DL+EQ-X)	200.059	188.511	185.382	201.545	202.436	180.907	39
Story 12	1.5(DL+EQ-X)	186.600	174.501	171.89	188.075	188.789	166.136	36
Story 11	1.5(DL+EQ-X)	172.378	159.697	157.649	173.814	174.384	150.564	33
Story 10	1.5(DL+EQ-X)	157.531	144.242	**144.556**	158.906	159.358	**136.041**	30
Story 9	1.5(DL+EQ-X)	142.184	128.271	143.177	143.483	143.834	134.853	27
Story 8	1.5(DL+EQ-X)	126.456	111.907	129.879	127.662	127.929	119.285	24
Story 7	1.5(DL+EQ-X)	110.451	95.267	112.843	111.549	111.747	101.642	21
Story 6	1.5(DL+EQ-X)	94.266	78.468	96.383	95.242	97.383	83.794	18
Story 5	1.5(DL+EQ-X)	77.986	**63.54**	79.795	78.826	78.921	**67.675**	15
Story 4	1.5(DL+EQ-X)	61.687	62.553	63.163	62.378	62.437	66.959	12
Story 3	1.5(DL+EQ-X)	45.433	47.571	46.553	45.962	45.995	50.75	9
Story 2	1.5(DL+EQ-X)	29.48	30.705	30.027	29.638	29.652	32.766	6
Story 1	1.5(DL+EQ-X)	13.333	13.997	13.682	13.501	13.504	14.943	3



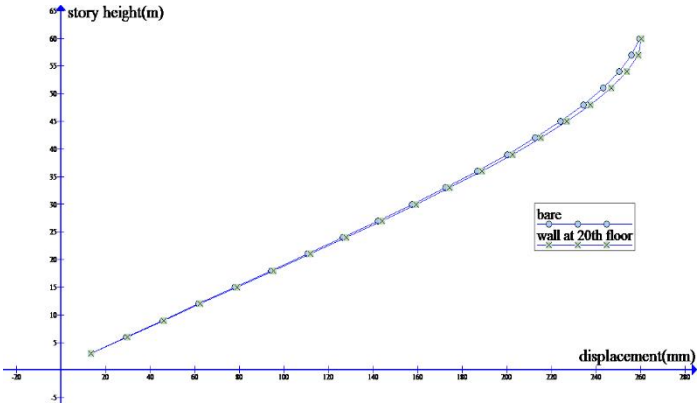
Graph 1 Story displacement between bare frame and Belt Wall at 5th floor



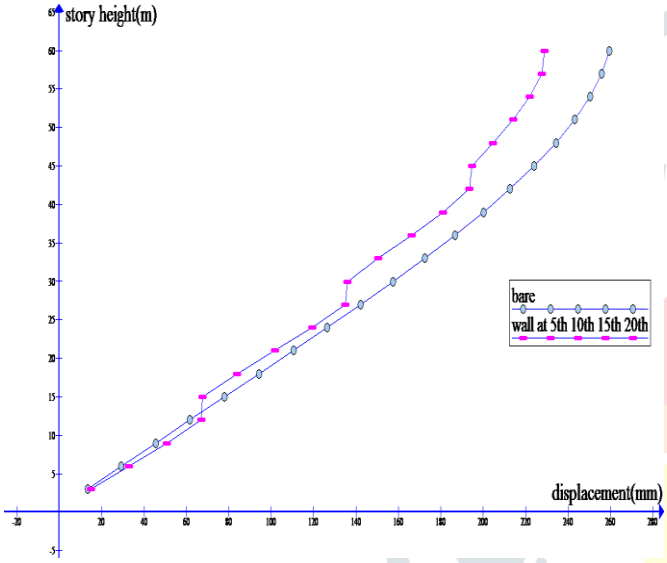
Graph 2 Story displacement between bare frame and Belt wall at 10th floor



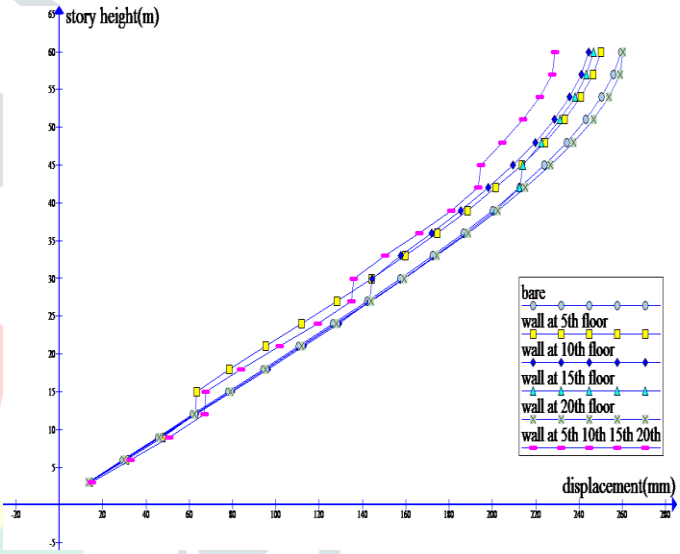
Graph 3 Story displacements between bare frame and Belt Wall at 15th floor



Graph 4 Story displacement bare frame and Belt Wall at 20th floor



Graph 5 Story displacements between bare frame and typically Belt Wall condition



Graph 6 Story displacements compare of all condition

4. CONCLUSION

In this study displacement (joint displacement) is considered at each floor of 20th story building. The comparison is made with 6 different conditions of Belt Wall at 5th, 10th, 15th, 20th and in one case of belt wall at all these floors with bare frame.

4.1. STORY DISPLACEMENT

1. Story displacement decreases at the level of Belt Wall and after that proportionally reduce at all floors level.
2. Maximum displacement is reduced in typically Belt Wall condition (belt wall at 5th, 10th, 15th, 20th floor).
3. Joint displacement with cap wall (belt wall at 20th floor) having less reduction in displacement, as compared to wall at other locations.
4. There is increment in displacement to adjutant floor when wall is connected at 20th floor.
5. Maximum variation for decrease and increase in displacement is found in when belt wall is connected in on 5th, 10th, 15th and 20th floor.
6. Maximum value of Joint displacement without any belt wall 259.430mm.
7. Maximum value of Joint displacement when belt wall is connected at 5th floor 250.111.mm.
8. Maximum value of Joint displacement when belt wall is connected at 10th floor 244.559mm.
9. Maximum value of Joint displacement when belt wall is connected at 15th floor 246.808mm.
10. Maximum value of Joint displacement when belt wall is connected at 20th floor 260.300mm.
11. Maximum value of Joint displacement when belt wall is connected at 5th, 10th, 15th and 20th floor 228.85mm.

12. Minimum value of Joint displacement without any belt wall 13.333mm.
13. Minimum value of Joint displacement when belt wall is connected at 5th floor 13.997mm.
14. Minimum value of Joint displacement when belt wall is connected at 10th floor 13.682mm.
15. Minimum value of Joint displacement when belt wall is connected at 15th floor 13.501mm.
16. Minimum value of Joint displacement when belt wall is connected at 20th floor 13.504mm.

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