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 respectively 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](image)

### 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
2.5 Slab
2.6 Wall

![Wall Property Data]

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 and Wall at 5th Floor]
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>
<thead>
<tr>
<th>Story</th>
<th>Load case/Combo</th>
<th>Bare Frame mm</th>
<th>Belt Wall at 5th floor mm</th>
<th>Belt Wall at 10th floor mm</th>
<th>Belt Wall at 15th floor mm</th>
<th>Belt Wall at 20th floor mm</th>
<th>Belt Wall at 5th,10th,15th,20th floor mm</th>
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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
4. CONCLUSION

In this study displacement (joint displacement) is considered at each floor of 20\textsuperscript{th} story building. The comparison is made with 6 different conditions of Belt Wall at 5\textsuperscript{th}, 10\textsuperscript{th}, 15\textsuperscript{th}, 20\textsuperscript{th} 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 5\textsuperscript{th}, 10\textsuperscript{th}, 15\textsuperscript{th}, 20\textsuperscript{th} floor).
3. Joint displacement with cap wall (belt wall at 20\textsuperscript{th} 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 20\textsuperscript{th} floor.
5. Maximum variation for decrease and increase in displacement is found in when belt wall is connected in on 5\textsuperscript{th}, 10\textsuperscript{th}, 15\textsuperscript{th} and 20\textsuperscript{th} 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 5\textsuperscript{th} floor 250.111.mm.
8. Maximum value of Joint displacement when belt wall is connected at 10\textsuperscript{th} floor 244.559mm.
9. Maximum value of Joint displacement when belt wall is connected at 15\textsuperscript{th} floor 246.808mm.
10. Maximum value of Joint displacement when belt wall is connected at 20\textsuperscript{th} floor 260.300mm.
11. Maximum value of Joint displacement when belt wall is connected at 5\textsuperscript{th}, 10\textsuperscript{th}, 15\textsuperscript{th} and 20\textsuperscript{th} 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.

REFERENCES