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Analysis and Optimization of RCC Building with Using Belt Truss Locations

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Abstract : There may be a huge demand for high-rise buildings in modern society and therefore the continued demand for development and high-rise buildings has created the necessity for more exceptional and efficient construction systems. One of such system in construction is that the Outrigger system. There are mainly two type of lateral loads are wind and seismic loads. To reduce the lateral deflection due to earthquake or wind forces, one of the most efficient and economical structural system used to knock out these challenges is the use of belt truss and outrigger truss. The objective of this paper is to optimize the location of belt truss in RCC Building to control the deflection or sway of Rcc frame. Here, Belt truss can be use as shear wall, hollow steel sections, braced sections and many more. In this paper, we are going to compare the results due to different locations of shear wall section. This structure is located in earthquake zone IV(India) on Hard rock strata. In this paper different results to be compared are storey displacement and story drift. Study provides comparison between the two, by analyzing and designing the G+24 irregular residential structure. By using belt truss at ideal location in RCC building, overall lateral deflection reduces by 22%. In the RCC building ideal location is obtained where the belt truss is applied at 13th & 14th floors. From this study the ideal location of belt truss, we can conclude that the lateral deflection of the high-rise structure can be reduce by applying the belt truss in the middle floors of Building.

***Keywords* — Belt truss, Lateral resisting system, storey displacementt, Storey drift, High-rise structures.**

I. INTRODUCTION

The development in high rise buildings has evolved rapidly in recent few years. Now a days population from rural areas is migrating in large numbers to metro cities. Because of this, metro cities and other city have gotten densely populated day by day. As population is getting denser the provision of land is diminishing and price is additionally increasing. Hence to beat these problems multi-storey buildings is most prominent and efficient solution. There's no formal definition for Tall Buildings, building having height quite 35 meters is taken into account as tall building. It doesn't necessarily depends on height but also the locality within which the building is to be constructed, as an example - A 12 storied building might not be considered a tall building during a High-rise city like metropolis or Singapore but might be considered a tall building in less developed cities. Development in tall buildings involves various compound aspects as an example, Shortage of land in urban areas, Increasing demand for business and residential space, Technological Advancements, Innovations in structural systems, economic process , Concept of city skyline, Cultural signification and prestige, Human aspiration to create higher In developing country like India and increased number of population, tall buildings may well be effectively wont to meet the strain of the technologically advancing society of our generation and solve the matter of less availability of land for construction and is most.

II. STRUCTURAL SYSTEMS

There are two categories in RCC framed structural building i.e. Interior structures and Exterior structures. When the foremost a part of the lateral load resisting system is found within the inside part of the building it's called as interior structure and if the foremost part of the lateral load-resisting system is found at the perimeter of the building, this method is categorized as an exterior structure.

Interior Structure

- Rigid Frames System
- Braced Hinged Frames System
- Shear Wall System
- Outrigger And Belt Truss Structure System

Exterior Structure

- Tube System/ Braced Tube / Tube In Tube Structural System
- Diagrid Structural System
- Space Truss Structural System

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- Super Frames System
- Exo-Skeleton Structural System

Each complex variety of this structural category, tall buildings are designed with different form of structural systems, like braced tube, diagrid and outrigger systems. Recently in commercial and residential construction industry, the belt truss and outrigger system is widely accustomed reduce lateral drift. The location of outrigger trusses in building increases the effective depth of the structure and significantly improves the lateral stiffness of the structure under lateral load.

Outrigger and Belt Truss as Structural System

The Outrigger and Belt truss system in RCC Building is usually used as one of the structural system to effectively control the excessive drift because of lateral load, so that, during small or medium lateral load because of wind or earthquake load, the danger of structural and non-structural damage will be decreased.

From many years' structure are built using belt truss and outrigger system for lateral load transfer. This technique is extremely effective when employed in tall buildings. The belt truss tied the peripheral column of building however the outriggers engross them with main or central shear wall. The outrigger concept is in widespread use today within the planning of tall buildings.

During this idea, "outrigger" trusses extend from a lateral load-resisting core to columns at the outside of the building. The core may encompass either shear walls or braced frames. The core is also centrally situated with outriggers extending on either side or in some cases it's going to be situated on one side of the building with outriggers extending to the building columns on the other side.

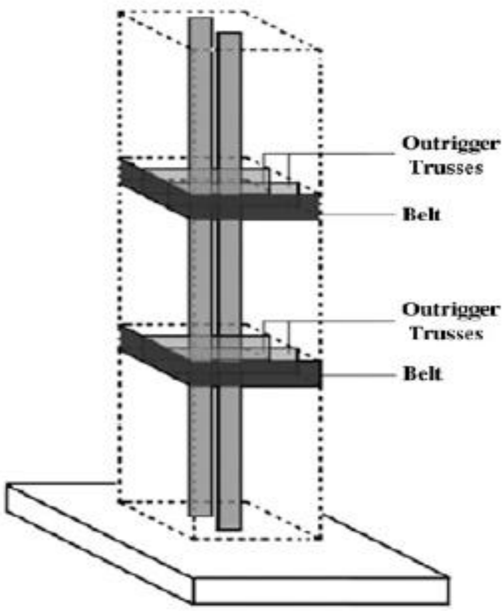

Figure 1 Multi-Level Belt Truss and Outrigger

III. OBJECTIVE & DETAILS OF STUDY

1) The main objective of present study is to study the use belt truss as a virtual outrigger truss placed at different location,
2) To control the deflection of multi-storied building against lateral loads acting through seismic load and wind load.
3) The study is restricted to reinforced cement concrete multi-storied structure. The analyzed model in study is real structure.

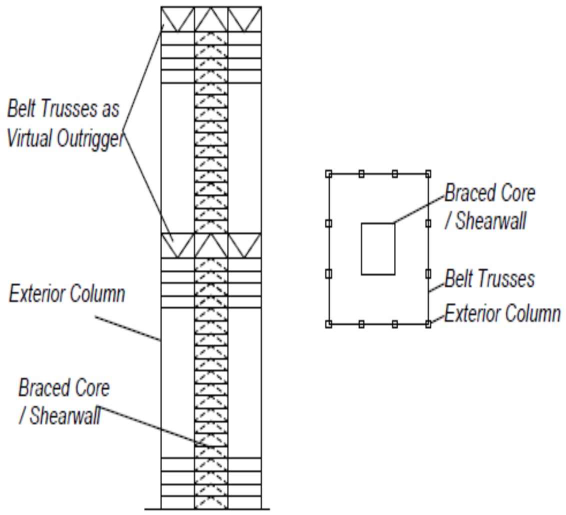

Figure 2 Typical Belt Truss Locations in a High-rise structural system

IV. CONFIGRATION OF BUILDING

1) In this paper an RC multistoried building is implementing with 24 stories belts truss use at different location
2) The use of belt truss in structural system as a virtual outrigger truss placed at different location of the building.
3) The use of belt truss in building to control the deflection of multi-storied building against lateral loads acting by seismic load and wind load.
4) The shape of building is irregular structure.
5) The Building in Seismic Zone IV, Wind Speed 44 m/s, Soil Condition Medium soil, Importance factor 1, Zone factor 0.24, Terrain category 3.
6) Analyzing the model with static as well as with dynamic loading and comparing the results is done.
7) Interpretation of result and formulation of conclusion will be done.
8) Plan and 3D model of building is shown in figure 3 & figure 4.

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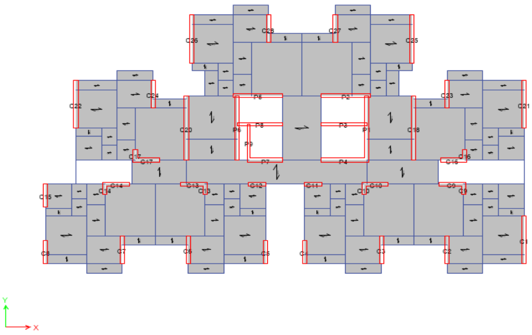

Figure 3 Plan of building at 13th floor

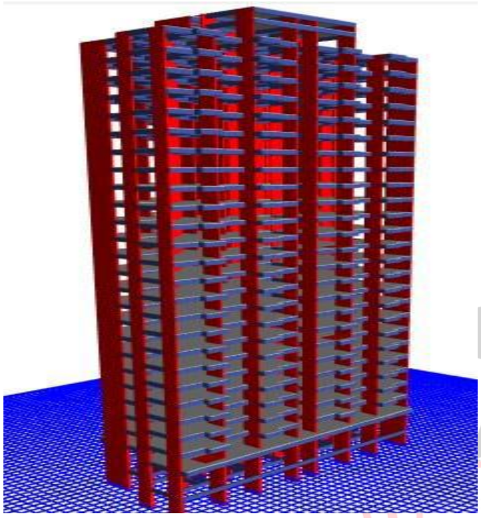

Figure 4. 3D model of structure

Table No 1 Structural data

Plan dimension	33.810m, 21.4m
Total height of building	80.2m
Height of each storey	2.9m
Height of parapet	1m
Grade of concrete	M35 , M40
Density of concrete	25 KN/m3
Grade of steel	Fe 500

Table No 2 Dimension

Type of Beam	Size of Beams
B1	150mmX300mm
B2	150mmX600mm
B3	150mmX700mm
B4	230mmX600mm
B5	230mmX700mm
Thickness of Shear Wall	150mm, 230mm 380mm, 430mm
Thickness of Slab	125mm, 140mm
Thickness of Wall	150mm- internal wall 230mm- external wall

V. RESULTS

4.1 Overview

This paper presents the analysis result of 24 storied RCC building. Analysis has been performed using ETABS software. The models are analyzed by equivalent static analysis for seismic in accordance with IS 1893-2002 and dynamic analysis method that is only response spectrum method for zone IV. The results are obtained from analysis and they are compared and discussed as follows.

4.2 Building without Belt Truss

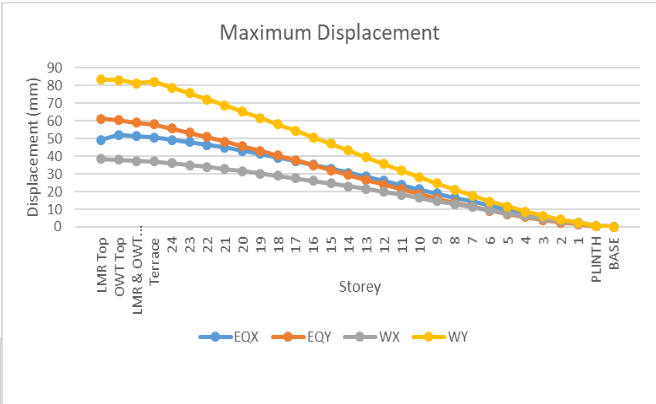

Figure 5 Maximum Displacement for Building without Belt Truss

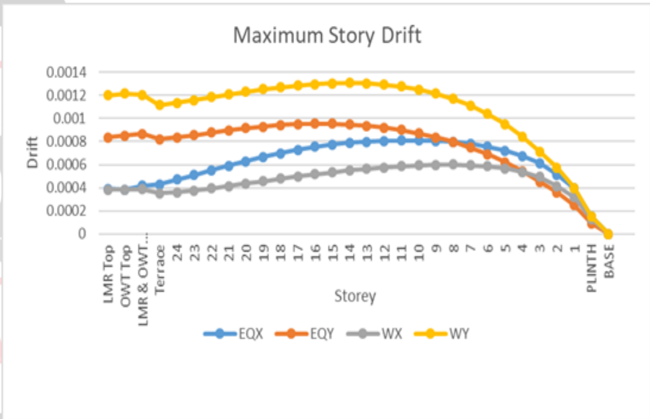

Figure 6 Storey Drift at Top for Building without Belt Truss

4.3 Single belt truss as in Shear (at 14th Floor)

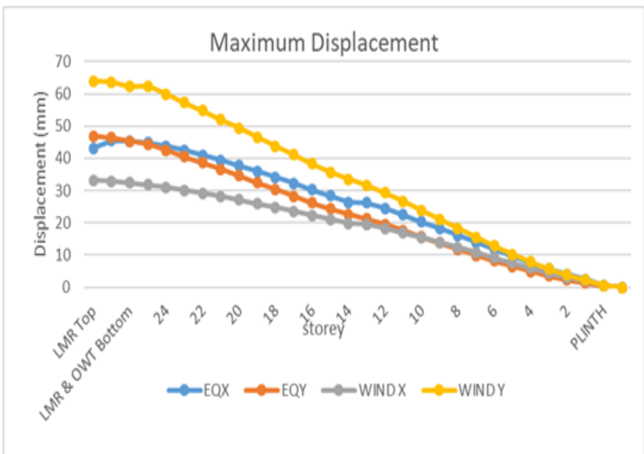

Figure 7 Maximum Displacement for single BT

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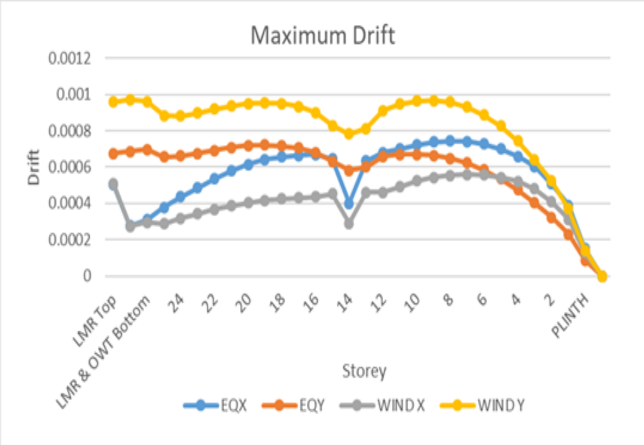

Figure 8 Storey Drift for single BT

4.4.1Maximum deflection and storey drift for two consecutive belt truss (at 13th and 14th Floor)

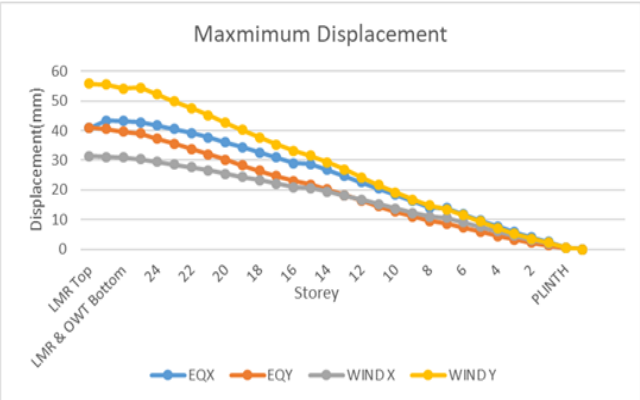

Figure 9 Maximum Displacement for two consecutive belt truss

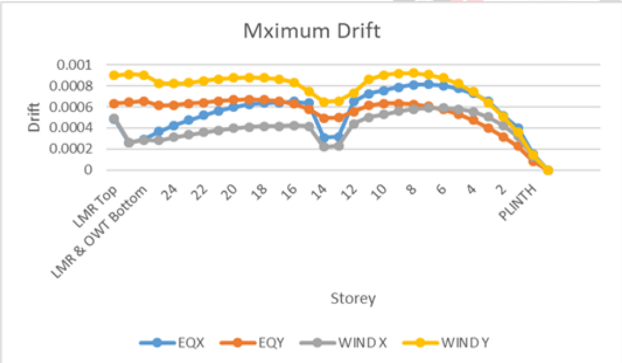

Figure 10 Storey Drift at Top for two consecutive belt truss

VI. CONCLUSION

Here, different techniques were proposed for the application of belt truss as an outrigger. As the results were shows, in the previous section, for G+24 building by applying belt truss at different locations. Thus from the discussion of above observations and results, we come to the following concluding statements as:

1. The use of belt truss RCC structural systems in high-rise buildings increases the stiffness of the structure and makes the structural form efficient under lateral load.

2. Results were found to be more less at different location, but the optimum location was observed at 13th and 14th floor.

3. Lateral displacement was reduced by 21% and 18% in Response spectrum method, while in wind it was reduced by 16% and 23% in X and Y direction.

4. Drift at particular floor was reduced by 48% and 42% in Response spectrum method, while in wind it was reduced by 44% and 49% in X and Y direction.

5. Provision of belt truss results in well distribution of design reaction and axial force in perimeter column that will help in column design to maintain same size of column and help to reduce column sizes.

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