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ANALYSIS OF G+45 BUNDLED TUBE STRUCTURE USING DIFFERENT BRACING SYSTEM UNDER THE EFFECT OF SEISMIC FORCES

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Abstract - Now a days, the construction of the high rise buildings has been increased which leads to the progress of the world. Main demand by the highly increasing population and businesses to be as close to each other as possible has leads to the development of the high rise buildings. High rise buildings are different from low rise buildings when subjected to wind and seismic loads due to its slenderness and because of these tall structures new difficulties arrives to the design engineers to design a building under all lateral loading conditions to increase the strength and stability of the structure bracings are provided. As the bracings have very high strength and stiffness bracings resist the large loads and also stiffer structure resists the large seismic force. In the high rise building the main work is to provide the lateral stability to the tall building. In this project G+45 bundled tube structure using different bracing system under the effect of seismic force is used. In this project G+45 RCC bundled tube structure is analyzed for RCC bare frame without bracing system and RCC Bare frame with bracing system. The result analysed are displacement, base shear, axial load, storey drift. Comparing all the results tabulated it is seen that for a building with X bracing in X-direction and Diagonal bracing in Z direction gives the best results.

Key Words: Bundled tube, Bracing, Unsymmetrical, Displacement, Base shear, Storey Drift etc

1. INTRODUCTION

Bundled tube structure is one of the good system for resisting all wind and seismic loads. Generally high rise buildings require more interest on resisting lateral load. There are many types of wind and seismic load resisting systems are present. In those systems bundled tube structure is one of the good system and common system to counter lateral loads. Tube in tube system, framed tube, Bundled tube, and braced tube system are mainly used tubular systems. In tubular system outer limits columns are closely spaced and bonded by beam. Gravity load is taken by outer and inner columns. Bundled tube system is behaved as one system when number of tubes ties together. In bundled tube system columns are more equally stressed and columns in bundled tube structure gives high lateral stiffness to building. Both concrete and steel materials are used for construction of bundled tube structure. Tubes are in many shapes like rectangle, triangle, square, trapezoidal, etc in bundled tube structure.

A tubular system which is a simple tube facing more twisting and overturning moment. A bundled tube is a group of individual tubes are associated to form high rise building. Inclined individuals can be provided for framework these are called braced bundled tube. Bundled tube structures are flexible for building planning. In bundled tube structure many tubes are arranged at its base and only one at its top level. As the height of building increases there will be decrease in number of tubes. This type is used for building where building is react against lateral loads.

1.1 LITERATURE REVIEW

1.Karthik A L, Geetha K [2016] [1] Analys the rectangular steel structure of 110 storey which is bundled tube structure with mega bracing and belt truss by dynamic analysis using ETABS software. In the study they have analysed the structures without and with the belt trusses and bracings and estimate the parameters of different structures. And limits like storey drifts, displacement and time periods base shear are taken from the analysis. From the analysis they noticed that the steel bundled tube system with belt truss and mega bracing framework has given high stiffness and stability as compared to other four structural systems.

2. Lakshmi S Nair, Nimiya Rose Joshuva [2016] [2]] has carried out the seismic analyses of tall structure using V and X type of belt truss with regular and twisting irregular concrete buildings. Using ETABS software dynamic analysis for G+30 storey building was carried out under seismic zone III. The results considered in this study are base shear, storey drift, and displacement and % difference is calculated to understand the stability of structure. In case of regular building X and V belt trusses showed the same achievement but in the irregular buildings belt X gives a good results than V belt.

3.Vijaya kumara Gowda MR, Manohar B C [2015][3] Stress analysis is the analysis of strength of solids if is based on theories of failure as proposed by researches like Gust, Misses Henks, Hais and Mohr. There is no great uniformly of opinion in determining elastic failure due to complex nature of failure. This paper use for design purpose IS456-2000 using Staad.pro software finally concludes with results of of maximum tresca stress are found to be desire as for analyzing the stress of shear wall is a concerned for the frame. It is designed as per IS456-2000 it is used for low height building. Balancing windward facing with Leeward facing and leeward facing is highly stressed at middle height.

4. Patel and Patel [6] Experimented design and analysis for tubular system after giving DL, LL, lateral seismic load and wind load. For lateral loads, both static and dynamic design were carried out. The structure is considered to be present in zone-V to consider maximum conditions of seismic and wind loads and find out that displacements on every story and story drifts are noted to be less in diagrid structure as compared to conventional building and allocate the large spacing between outer limit columns for bundled tube structure in compare to framed tube structure. Bundled tube structural system has given good results for wind and seismic loads in terms of story drift, lateral displacements, stiffness and base shear and it is highly stable to resist wind load up to large heights.

1.2 OBJECTIVES

In this project G+45 RCC bundled tube structure is analyzed under the effect of lateral forces such as seismic forces for Zone IV considering different bracing system.
Type of structure analyzed:

I. RCC bare frame without bracing system.
II. RCC Bare frame with bracing system.

Types of bracing system used are as follows:

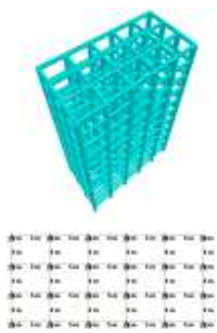
I. V-Bracing system
II. X bracing system
III. Diagonal bracing system
IV. Inverted bracing system
V. K bracing system

In this project, analysis of structure is done using STAAD Pro V8i., the comparison of structural behavior is observed such as joint displacement of building, storey drift, Base shear, Axial load at base and providing perfect model with perfect brace system to this type of building after results and discussion.

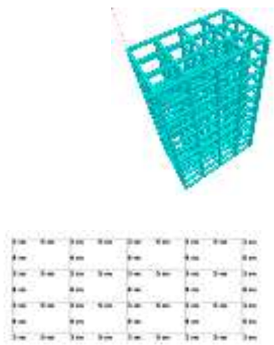
2. METHODOLGY

- Planning of G+45 RCC bundled tube structure using AutoCAD.
- Calculation of Dead load for different members using IS: 875(part I).
- Calculation of Live load using IS: 875(part II).
- Calculation of Wind load using IS: 875(part III).
- Designing of structure to check failure of section and to get stable structure using IS: 456-2000.
- Modeling of G+45 structure using STAAD_PRO for the mentioned systems& analysis the same to check the difference of behavior of Structure as mentioned above in objective.
- Checking the behavior after analysis and represented in terms of table and using Graphical representation.

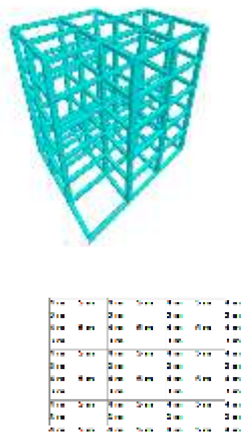
Fig.2.1. Conventional building plan



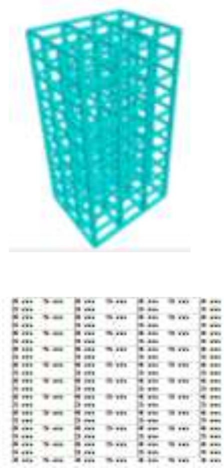
0 to 10 Floors



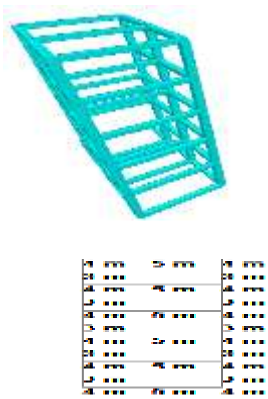
11 to 20 Floors



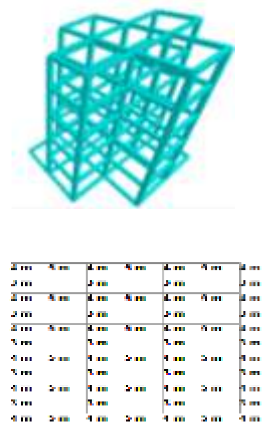
21 to 30 Floors



31 to 35 Floors



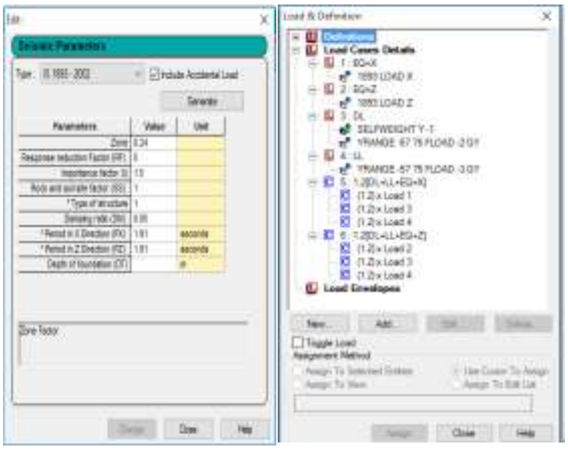
36 to 40 Floors



41 to 45 Floors

Fig.2.2. 3D View

Loads Considered



3. RESULTS

3.1. Results for displacement in x & z direction

- Maximum displacement is at 34th floor in X-direction & at 29th floor in Z-direction.
- Convention building to building with V brace = [(412.116-182.079)/412.116]*100 = 55.81% in X [UPTO 60.7%] & [(547.69-330.561)/547.69]*100= 33.64% [UPTO 44.5%] in Z.
- Convention building to building with X brace = [(412.116-159.676)/412.116]*100= 61.25% in X [UPTO 65.6%] & [(547.69-309.921)/547.69]*100= 43.41% in Z [UPTO 47.9%].
- Convention building to building with diagonal brace= [(412.116-210.204)/412.116]*100 = 48.99% in X [UPTO 52.2%] & [(547.69-302.586)/547.69]*100= 44.75% in Z [UPTO 51.4%].
- Convention building to building with inverted V brace = (412.116-172.677)]/412.116]*100=58.1% in X [UPTO 62.5%] & [(547.69-310.857)]/547.69]*100=43.24% in Z [UPTO 48.0%].
- Convention building to building with K brace= [(412.116-216.793)/412.116]*100= 47.63% in X [UPTO 60.7%] & [(547.69-314.489)/547.69]*100= 42.58% in Z [UPTO 49.3%].

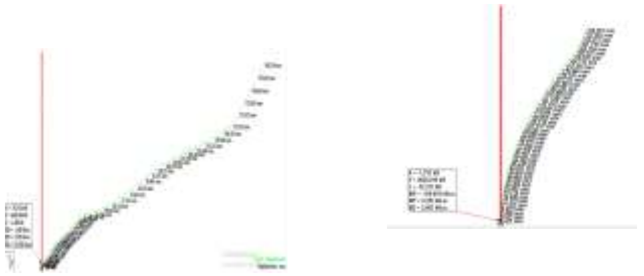


Fig.3.1.1. Displacement in X and Z direction for V bracing

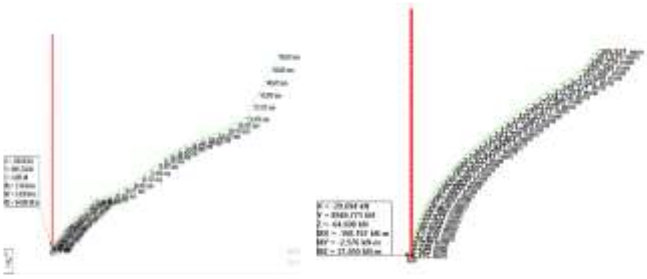


Fig.3.1.2. Displacement in X and Z direction for X- bracing

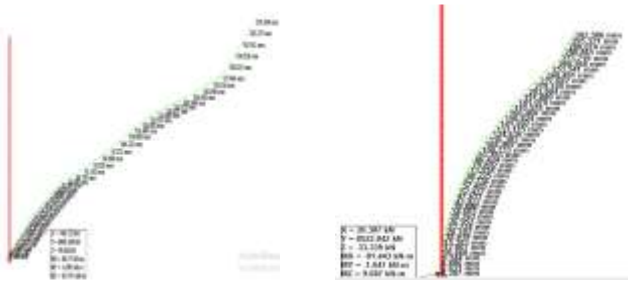


Fig.3.1.3. Displacement in X and Z direction for Diagonal bracing

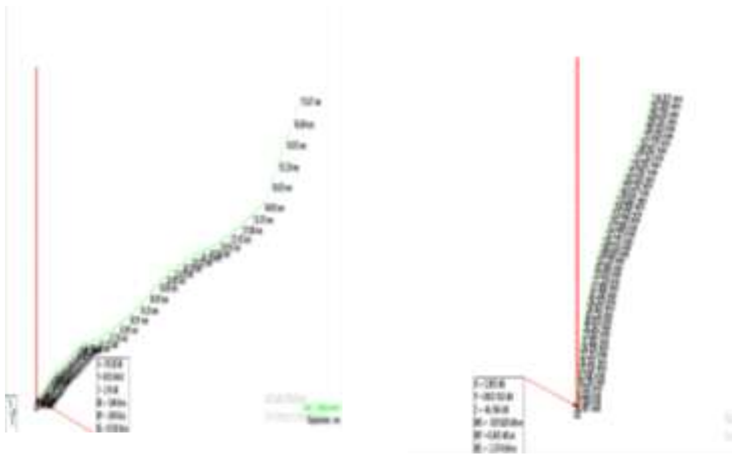


Fig.3.1.4. Displacement in X and Z direction for Inverted V-brace

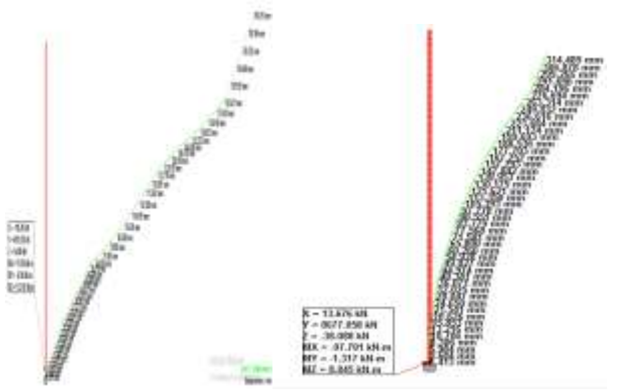


Fig.3.1.5. Displacement in X and Z-direction for K bracing

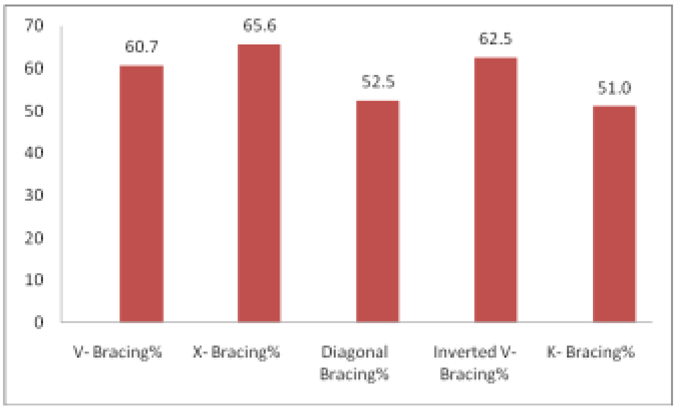


Fig.3.1.6 Maximum Displacement at 34th Floor in X-Direction

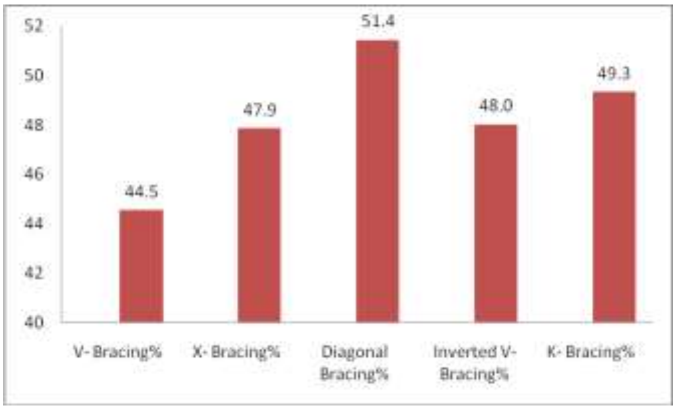
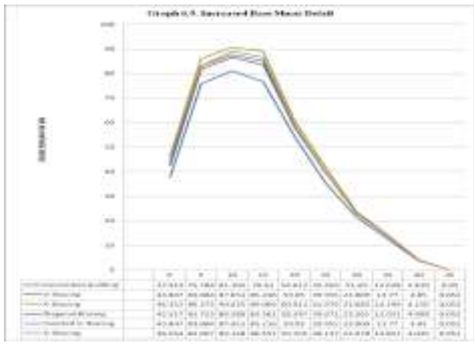


Fig.3.1.7. Maximum Displacement at 29th Floor in Z-Direction

3.2. Results For base shear in X & Z direction

- Base shear is maximum at 10th floor all type of building.
- Base shear is increased maximum in building with X bracing about 15.6 % [10%-16%] when compared with conventional building.
- Base shear is increased minimum in building with diagonal bracing about 9.1% [8%-12%] when



compared with conventional building.

Fig.3.2.1. Increased base shear detail

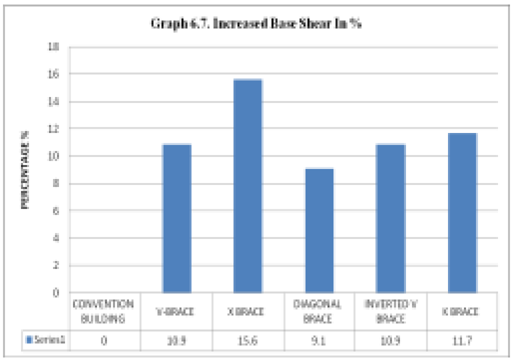


Fig.3.2.2. Increased base Shear In %

3.3. Result for storey drift in X & Z direction:-

- Story drift is maximum at 25th floor in convention building and all other building story drift is maximum at 40th floor in both X & Z direction.
- Convention building to building with V brace = [(10.546-6.595)/10.546]*100=37.46% in X& [(15.139-13.334)/15.139]*100 = 12.25% in Z.
- Convention building to building with X brace = [(10.546-5.896)/10.546]*100= 44.1% in X& [(15.139-12.994)/15.139]*100= 14.17% in Z.
- Convention building to building with diagonal brace= [(10.546-6.914)/10.546]*100 = 34.44% in X& [(15.139-13.025)/15.139]*100= 13.96% in Z.

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- Convention building to building with inverted V brace = (10.546-6.198)]/10.546]*100= 41.23% in X& [(15.139-12.658)]/15.139]*100=16.4% in Z.
- Convention building to building with K brace= [(10.546-7.162)/10.546]*100= 32.1% in X & [(15.139-13.38)/15.139]*100= 11.62% in Z.

Fig.4.1. X Brace in X Direction

3.4. Axial Force Result

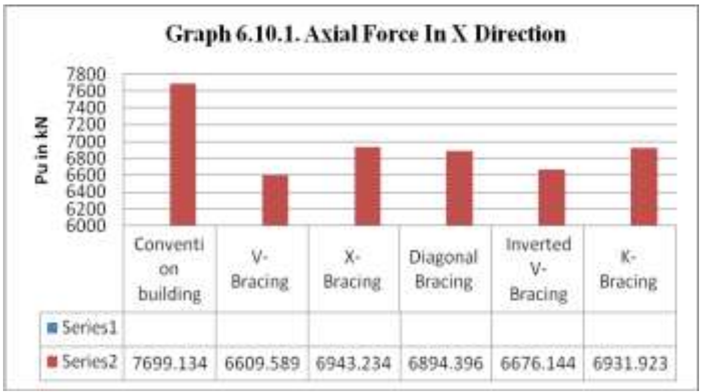

Fig.3.4.1. Axial Force In X Direction

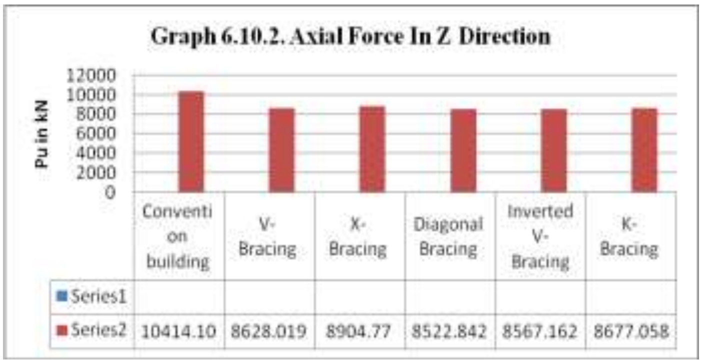

Fig.3.4.2. Axial Force in Z Direction

Fig.4.2. Diagonal Brace in Z Direction

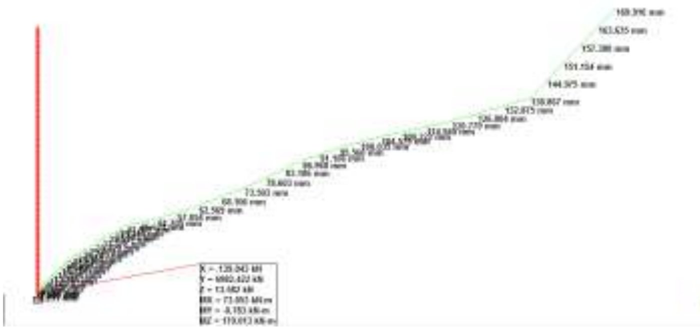

Fig.4.3. Displacement in X – Direction

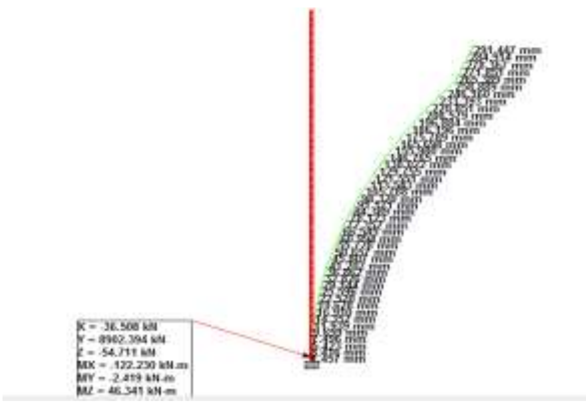

Fig.4.4. Displacement in Z – Direction

4. CONCLUSIONS

After All Discussion X Brace And Diagonal Brace Is Good For This Type Of Structure So The Model Below Shows Conventional Building With Diagonal Brace In Z Direction & X Brace In X Direction.

- When displacement is considered X-bracing is giving high result as stiffness is higher due to X brace where displacement is reduced up to 61.25% when compared with conventional building in X direction.
- Next to X- bracing inverted V bracing is also giving higher result where displacement is reduced up to 58.1% and also base shear is less than X bracing in X Direction.
- In Z direction diagonal bracing system is giving higher result where displacement is reduced up to 44.75% when compared with conventional building and also K bracing system is also giving higher result where displacement is reduced up to 42.58% compared with conventional building.
- When storey drift is considered X & inverted V bracing is giving higher result (ie; 44.1% & 41.23%) in X direction and, In Z direction inverted V bracing is giving higher result as 16.4%.
- When base shear is considered diagonal bracing is very less increased ie; 9.1% compared to conventional building & also V bracing as well as inverted V bracing is also less increased by 10.9%.
- When axial force is considered V brace is reduced by 14.15% among all other condition in X direction & diagonal bracing is reduced by 18.16% among all other condition in Z direction.
- For building with X and Diagonal brace displacement reduced by58.8% in X & 46.78% in Z.
- For building with X and Diagonal brace Base shear is increased by 10.5%.
- For building with X and Diagonal brace Axial force is reduced by 9.30% in X & 14.51% in Z.

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