Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 4, No. 4, April : 2023

ANALYSIS OF DIFFERENT HEIGHTS OF 20,30,40&50m HIGH RISE BUILDINGS UNDER WIND AND SESMIC LOADS

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Abstract

High rise buildings become common in the modern growing cities as the height of the building increase for the given width, the building frame becomes more flexible particularly in the case of frames with heights above 15 stories slenderness becomes more and fundamental frequency of the frames becomes less. The wind pressures are fluctuating the nature and this is illustrated by the wind spectrum. When the wind pressures the high rise building Sometimes causes oscillations which may even cause discomfort to the occupants even if it is not in a threatening position for the structural damage

In the present project a building with different heights is analyzed for wind as well as for earthquake loads for different load combinations. Considering a building with height of 20m, 30m, 40m,50m, in worst condition i.e,, in ZONE-III& SOIL-3 and analyzed for load combinations 1.2(DL+LL+LATERAL LOAD) in X direction with lateral load resisting systems. Results of displacement, storey shear, moment are compared for load combinations in both static & dynamic analysis. Results are tabulated and a optimum solution is concluded. A commercial package ETABS has been utilized for analyzing high-rise building. The result has been compared using tables & graph to find out the most optimized solution. Concluding remark has been made on the basis of this analysis & comparison tables.

I. Introduction

All over the world bracing system has been considered as the most efficient measure against the lateral loads induced in the building due to the seismic forces. This paper aims at providing an efficient bracing system against such forces.In order to increase the stiffness of the columns and to reduce their net longitudinal reinforcement decreasing their effective length can be a good solution but the challenge is to how can we do so without changing the general building specifications(specially architectural) and not upgrading strategy to enhance the global stiffness and strength of steel and composite frames. It can increase the energy absorption of structures and/or decrease the demand imposed by earthquake loads. Structures with augmented energy dissipation may safely resist forces and deformations caused by strong ground motions. Generally, global modifications to the structural system are conceived such that the design demands, often denoted by target displacement, on the existing structural and non-structural components, are less than their capacities(Figure 1). Lower demands may reduce the risk of brittle failures inthe structure and/or avoid the interruption of its functionality. The attainment of global structural ductility is achieved within the design capacity by forcing inelasticity to occur within dissipative zones and ensuring that all other members and connections behave linearly.

1.1Use of bracing system in decreasing the effective length of the column A new bracing system shaped like a diamond is incorporated in the main building frame and

Industrial Engineering Journal
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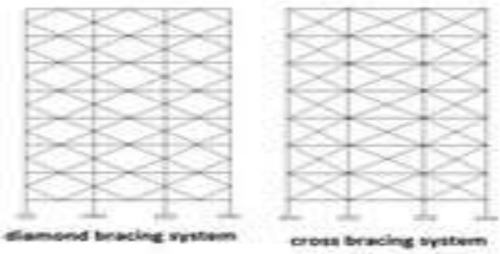
its applicability is evaluated by detailed calculations. It is also compared with the other known bracing system known as the cross bracing system. Both the bracing system has been shown below



Showing different types of bracings Bracing is a very effective global

Building dimensions The building is 18m x 18m in plan with columns spaced at 6m from center to center. A floor to floor height of 3.0m is assumed. The location of the building is assumed to be at zone-11,111,1V& soil-3.

Column Sizes & Beam Sizes for 20m Height Building Column size : 450mm X 650 mm Beam size : 350mm X 450 mm

Column Sizes & Beam Sizes for 30m Height Building Column size : 500mm X 650 mm Beam size : 400mm X 450 mm

Column Sizes & Beam Sizes for 40m Height Building Column size : 550mm X 700 mm Beam size : 450mm X 550 mm

Column Sizes & Beam Sizes for 50m Height Building Column size : 600mm X 750 mm Beam size : 450mm X 600 mm

Bracing size:230mmx230mm, **Slab thickness:** 120mm,

Live load: 2KN **Floor Finish:** 1KN **Mix proportion:** M30

Grade of steel : Fe 500

Load Combination: (DL+LL+EQX+WIND X) 1.2 Dead load- 1.2

Live load- 1.2
EQX- 1.2
WINDload X -1.2
Windward Coefficient: 0.8 Leeward coefficient: 0.5

LITERATURERE VIEW

Matthy's and Noland (1989) estimated that more than 70% of the buildings inventory worldwide is masonry buildings. Moderate to strong earthquakes can devastate complete cities and villages resulting in massive death toll and cause extensive losses. Most of these losses are caused by failure of unreinforced masonry (URM) buildings. Since demolition and replacement of these masonry structures is generally not feasible due to several factors this raises the question whether such buildings should be retrofitted. Nuti and Vanzi (2003) proposed a simple procedure to make a

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decision whether it is economically pertinent to retrofit a structure or not. Although a variety of technical solutions have been implemented for seismic retrofitting, there exists little information or technical guidelines with which an engineer can judge the relative merits of these methods. Furthermore, no reliable analytical techniques are available to evaluate the seismic resistance of retrofitted masonry structures. He reviewed common conventional techniques used in retrofitting of existing URM buildings. Common causes of damage and failure of URM buildings as well as a state-of-the-art of modern retrofitting techniques (e.g. Composites) is presented in ElGawady (2004a, b).

Viswanath K.G , Prakash K.B , Ananth Desai :Steel braced frame is one of the structural systems used to resist earthquake loads in multistoried buildings. Many existing reinforced concrete buildings need retrofit to overcome deficiencies to resist seismic loads. The use of steel bracing systems for strengthening or retrofitting seismically inadequate reinforced concrete frames is a viable solution for enhancing earthquake resistance. Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for meeting the required strength and stiffness.

In the present study, the seismic performance of reinforced concrete (RC) buildings rehabilitated using concentric steel bracing is investigated. The bracing is provided for peripheral columns. A four storey building is analyzed for seismic zone IV as per IS 1893: 2002 using STAAD Pro software. The effectiveness of various types of steel bracing in rehabilitating a four storey building is examined. The effect of the distribution of the steel bracing along the height of the RC frame on the seismic performance of the rehabilitated building is studied. The performance of the building is evaluated in terms of global and story drifts. The study is extended to eight storied, twelve storied and sixteen storied building. The percentage reduction in lateral displacement is found out. It is found that the X type of steel bracing significantly contributes to the structural stiffness and reduces the maximum inter storey drift of the frames.
Myron Goldsmith (1918-96) was a unique figure in the development of tall building design. He successfully blended the roles of architect, engineer and teacher throughout his tenure at Skidmore Owings and Merrill (SOM) and in the Department of Architecture at the Illinois Institute of Technology (IIT). Indeed, many of the projects supervised by Goldsmith and his colleagues, to include the pre-eminent structural engineer Dr Fazlur Khan (1929-82), directly influenced built work.
The few published studies of Goldsmith acknowledge, but do not fully explore, the innovations that Goldsmith oversaw as thesis advisor to many graduate students at IIT in the 1960s. An essential link between the student work and the large-scale office projects at SOM were the “Saturday Sessions.” There, architects, engineers and students met for weekly reviews at IIT and then a lengthy and lively lunch at Bertucci’s restaurant in Chicago. Goldsmith encouraged the free exchange of scholarly and practical ideas during these Saturday Sessions and we argue that this was a vital part of Goldsmith’s pedagogy. This paper will focus on a fascinating network of students, architects, and engineers that led to the innovation of the diagonally braced tube tall building.

Syed Rehan, S.H. Mahure : Presented the work on analysis and design of (G+15) Stories under the effect of earthquake and wind for Composite, Steel and RCC structure. The modelling and analysis is done by using Staad pro. And they compare the result of Composite, RCC and steel building such as story displacement, story drift and Maximum bending moment and shear forces. They suggest that composite structure is better option compare to RCC and Steel.

Abhay Guleria : They presented the work on structural analysis of multi story building under the effect of earthquake for RCC structure for different plan configuration. The modelling and analysis is done by using ETABS software. And they compare the result of different plan configuration buildings such as story overturning moment, story shear, story drift and mode shapes.

Jawad Ahmed, H S Vidyadhar : They presented the work on wind analysis of multi story buildings with different lateral load resisting system for different aspect ratio. The modelling and analysis is done by using ETABS software and the total forty five models are prepared. They suggest that RC shear wall is better to resist lateral loads compared to RC double bracing.

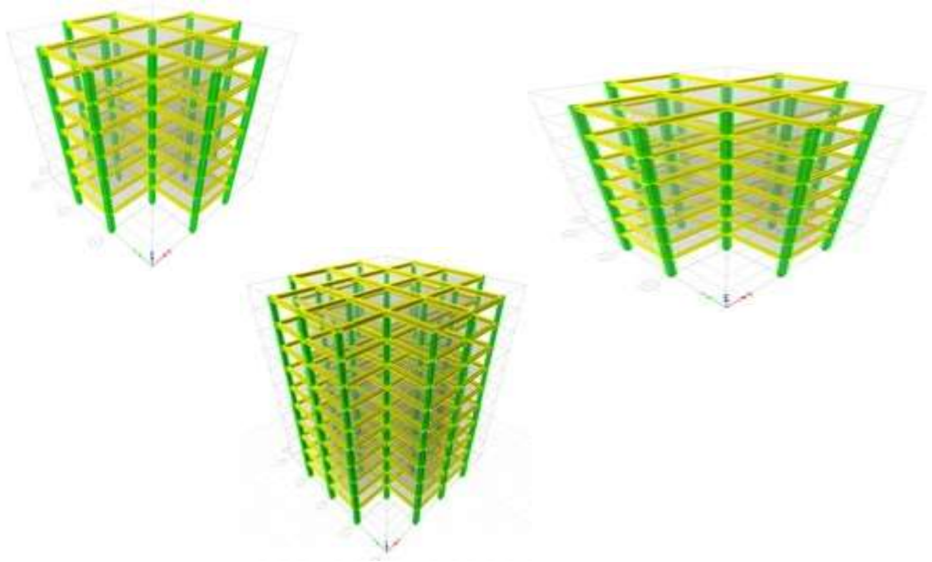
Swati D. Ambadkar, Vipul S. Bawner : They presented the analysis of (G+11) multi story building for different terrain category in significant relation of moment, forces and displacement. The modelling and analysis is done by using Staad pro. Software. For the analysis basic wind speed are taken 44 m/s, 47m/s, and 50m/s. They conclude that wind speed increases bending moment values also increases according to category.

2.1 Load Cases

2.2.1. Live Load

Live load is assumed as per IS 875(part 2-imposed loads) table 1. the building is analysed by assuming it to be a residential building the live load was taken as $2KN/m^2$

2.2.2. Earth Quake Load Earth Quake load in this analysis is accordance to IS 1893(part 1)- 2002. The buildings models are prepared in all seismic zones i.e. Z2, Z3, Z4 and Z5. Therefore the value of Z is taken as 0.1, 0.16, 0.24 and 0.36 respectively. And the models are made in all types of soils i.e., Hard/ Rocky (Type I), Medium soil (Type II) and in Loose soil (Type III).



Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 4, No. 4, April : 2023

Fig:2.1Showing 3D view of 30m height building

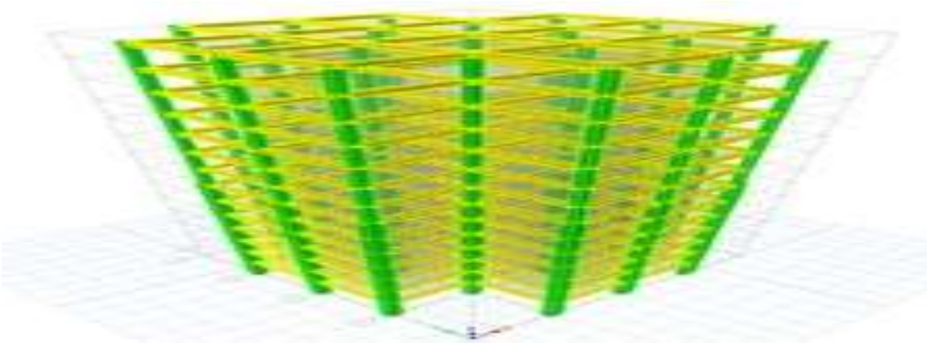


fig 2.2 Showing 3D view of 40m height building

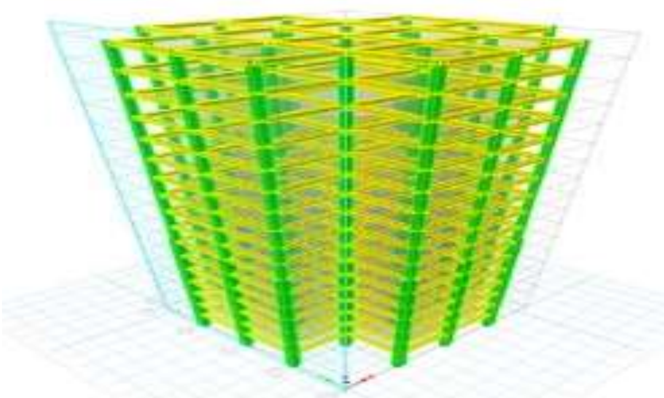
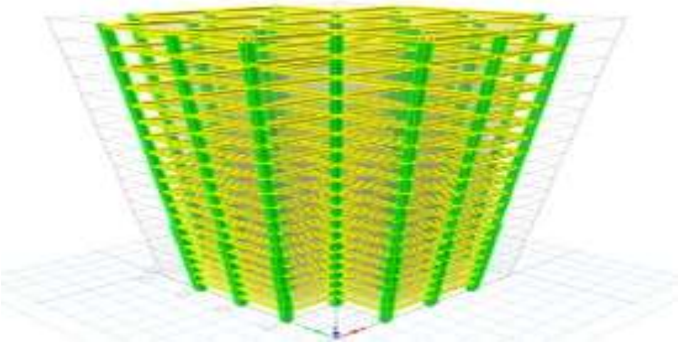


Fig 2.4 Showing 3D view of 50m height building



RESULTS

Shear comparison in Zone-5 Soil-3 for 20m,30m,40m,50m heightbuildings in static analysis.

Industrial Engineering Journal
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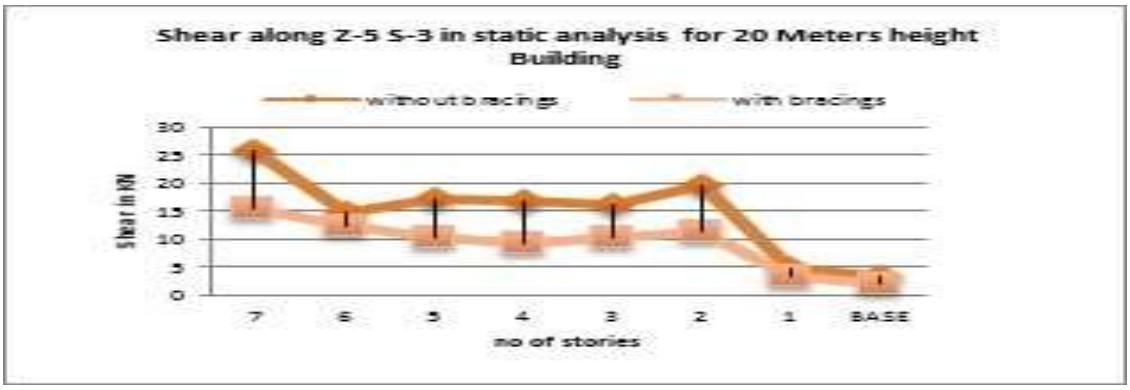
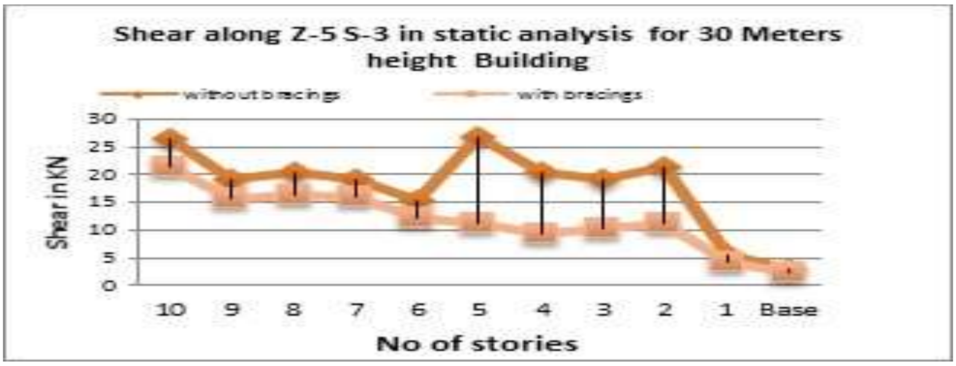
Comparative values of shear of 20m height building in Zone-5 Soil-3in *static* Analysis.

storey	without bracings	with bracings
7	25.7	15.34
6	14.8	12.34
5	17.1	10.3
4	16.7	9.23
3	16.1	10.32
2	19.6	11.23
1	4.8	3.32
BASE	3.45	2.1



Comparative values of shear of 30m height building in Zone-5 Soil-3in static Analysis.

storey	without bracings	with bracings
10	26.5	21.4
9	19.3	15.6
8	20.5	16.3
7	19.3	16.11
6	15.4	12.23
5	26.7	11.23
4	20.6	9.3
3	19.3	10.3
2	21.3	11.32
1	5.4	4.3
Base	3	2.34

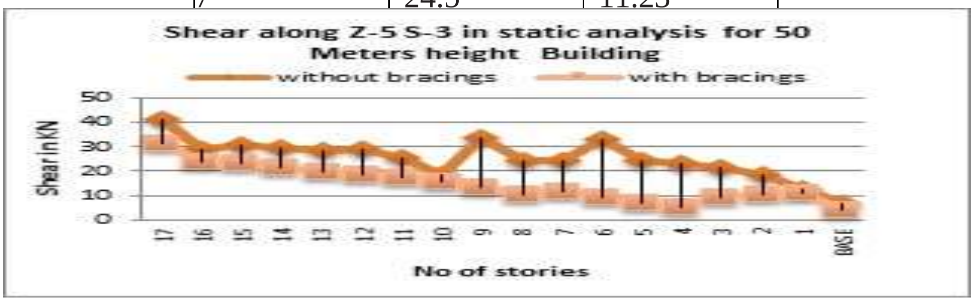


Comparative values of shear of 40m height building in Zone-5 Soil-3in static Analysis.

storey	without bracings	with bracings
14	36.3	25.5
13	24.4	18.7
12	26.4	18.9
11	25.3	18.6
10	24.5	18.34
9	17.32	13.287
8	32.43	26.3
7	24.34	19.4
6	24.3	15.34
5	23.4	12.43
4	21.3	11.32
3	15.45	10.43
2	5.906	3.45
1	3.54	2.3
BASE	2.45	1

Comparative values of shear of 50m height building in Zone-5 Soil-3 in static Analysis.

storey	without bracings	with bracings
17	40.9	31.23
16	28.9	23.45
15	30.7	23.32
14	29.6	21.4
13	28.5	19.45
12	28.7	18.34
11	25.4	17.34
10	18.5	15.34
9	33.5	13.23
8	24.3	10.34
7	24.5	11.23



CONCLUSIONS

1. The structural performance is analyzed in different heights of building i.e. Without bracings, With X Bracing, the displacement of 45% is reduced when lateral systems are provided.

2. Shear is also analyzed for both the models, Shear of 40% is reduced when the lateral systems i.e,, X bracings are provided.

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