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Investigation of Behavior of Combined Effect of X and Diamond Bracing System for High Rise Steel Structure

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Abstract: The aim of present study, "Investigation of behavior of combined effect of x and diamond bracing system for high rise steel structure. "By using STAAD. pro v8i. The objective of this paper is to analysis and design different parameter in high rise steel structure by using staad.pro v8i. In this paper G+20 storied building considered and various lateral load like wind load and seismic load. Analysis the result obtained in staad.pro for efficient bracing system.
Keywords: Bracing system, High rise steel structure, Lateral loads.

I. INTRODUCTION

An emerging demand for earthquake resistant structure provokes new trends in seismic analysis. Earthquake is a natural calamity which is very much unpredictable and causes a large damage to the structures even resulting in the failure of the entire structure. Thus, the buildings and structural frames must be designed such that they can withstand a large earthquake force and maintain its stability for its entire life period. Due to earthquake, these structures are susceptible to collapse or undergo large lateral displacements. This displacement can be brought into limit by providing the ductility in the structure. This ductile behavior can be achieved by the stable plastic deformation of structural members. There are various techniques which are used to limit the deformation due to lateral loading bracing system is one of them. Bracing system consists of inclined members in addition to the moment resisting frame system. Conventional bracings are the secondary members which undergoes large deformation and yields under earthquake loading. Braces save primary members from damage. There are certain limitations of conventional bracing system such as buckling of compression brace member under compressive loading. Buckling in compression leads to sudden loss stiffness. To avoid buckling of bracing buckling restrained bracings have developed, in which buckling is prevented. Moment resisting frame (MRF) possess high ductility while concentric bracing system possess high stiffness, to achieve appropriate ductility and stiffness, O grid bracing system have developed. To achieve both high stiffness and energy absorption capacity, a new type of bracing system have developed known as braced ductile shear panel. Braced ductile shear panel provides high stiffness, excellent energy absorption capacity and stable hysteresis characteristics. Different bracing systems have developed to achieve various parameters. (M.Boostani 2018)

To study the behavior of different bracing systems and frames, various analysis methods have developed. To study the linear stress strain behavior of structure linear dynamic analysis is carried out. Response spectrum analysis is a linear dynamic analysis method. In response spectrum method lateral seismic load is obtained from dynamic response of building subjected to respective ground motion. Vibration modes have determined following to the linear dynamic analysis. Maximum response of each mode is obtained by using vibration period of mode. Seismic forces for linear design of building are obtained from linear spectrum that depends on natural period of building and soil condition. FEM (finite element modeling) helps to calculate response of each mode separately. The maximum response can be calculated by using statistical method such as SRSS (square root sum of squares) and CQC (complete quadratic combination). In response spectrum analysis minimum 3 first modes or all the modes that include at least 90% (IS 1893) of the participating mass of structure. To study the non linear stress strain behavior of structure non linear static analysis is carried out. Non linear static analysis also called as pushover analysis. It is use to determine seismic structural deformation. To obtain the performance of structure displacement, base shear are provided to structure and it reveals yield and failure points. Response spectra are curve plotted between maximum response of SDOF system subjected to specified earthquake ground motion and its time period or frequency it gives peak structural responses under linear range which can be used for obtaining lateral forces developed in structure due to earthquake.

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II. OBJECTIVES

The following are the main objectives of proposed work

A. To study effect of X and Diamond bracing system analytically and experimentally.
B. To study combined effect of X and Diamond bracing system analytically and experimentally.
C. Comparative study of performance of X , Diamond and Combined X and Diamond bracing systems so to get economical bracing system
D. To investigate behavior of efficient bracing system in high rise steel structure.
E. To Suggest guidelines for selecting economical bracing system.

III. METHODOLOGY

Following methodology is adopted for dissertation work:

A. Linear and non linear analysis of different bracing system.
B. Analysis of different bracing system by using industry grade software such as STAAD Pro or Etab's software.
C. Compare Staad.Pro Software results by experimentally.

IV. MODELING

In this paper, G+20 high rise steel structure having plan size 20m x 20m for a x and z direction respectively. Floor to floor height of building is 3m and 5 bays of 4m each along x and z direction. The lateral loads act on building based on Indian Standard. The building is construct on zone III as per IS 1893 (part I) 2002 and basic wind speed 39m/s as per IS 875 Part3 1987. For this site location medium soil strata is assume.

A. Beams and Column Schedule

Floor	Column section
1 to 11	UPT12 section
12 to 14	ISWB600400 x 2040
15,16	ISWB600350 x 2040
17,18	ISWB550350 x 2040
floor	Beam Section
All (Inner and Outer beam)	ISLB400
Bracing angle section	ISA 120 x 80 x 12
Eccentricity of eccentric bracing system	750 mm

B. UPT 12 Section Property

D	1000 mm
Tf	50 mm
Wf	400 mm
Tw	30 mm
Tf1	50 mm

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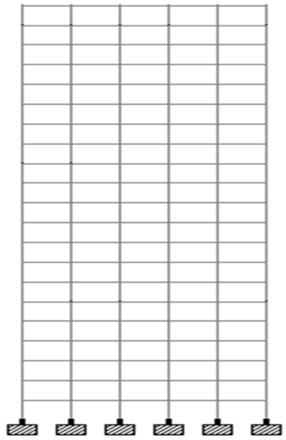

Fig no.1-Without brace

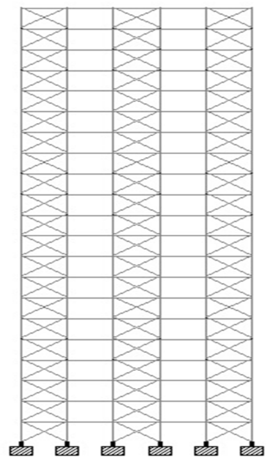

Fig no.2- Concentric x- brace

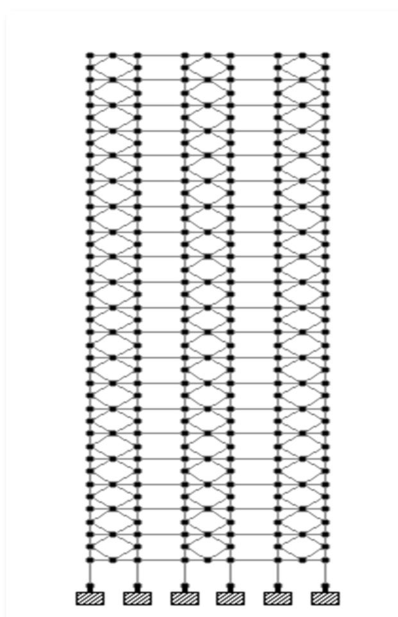

Fig no.3-Conc.Diamond Braced Model

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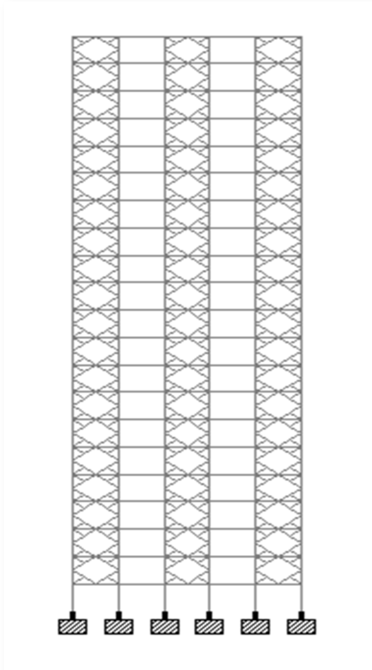


Fig no.4-Conc.X & Diamond Braced Model

V. LOADING

1) *Dead load*

Self weight of R.C.C slab -
Self weight = thickness x Density
= 0.150 x 25
= 3.75 kn/m2
Assume floor finish = 1 kn /m2
Total self weight of slab = 4.75 kn /m2
Calculation of self weight of brick wall having 12 mm plastering:-
Thickness of brick wall = 230 mm
Total self weight of brick wall = (0.230 x 20 x 3) + 2 (0.012 x 22 x 3)
=15.38 KN /M

2) *Live Load:* 2 kn / m2 over a slab up to 63 floors
3) *Seismic Load:* According to I.S 1893-2002 part 1 the design horizontal seismic coefficient Ah for a structure shall be determined by following expression:

$$Ah = \frac{Z\ I\ Sa}{2\ R\ g}$$

Zone factor, Z	0.16 for zone III
Importance Factor, I	1.5
Type of soil	Medium Soil
Response reduction factor, R for without and with braced models.	5
Fundamental Damping ratio	0.05

4) Wind Load: It can be mathematically expressed as follow:
Vz = Vb x k1 x k2 x k3

Basic wind speed, Vb	39m/s
Risk co-efficient factor, K1	1.06
Terrain, Height and structure size factor, K2	Varies with respect to height
Topography factor, K3	1

VI. RESULT

All loads and load combinations are considered for the comparison but results are presented for maximum load cases.

A. Maximum Joint displacement at top Storey in z Direction.

Model	Lateral displacement
Without brace	285.978
Conc. X- brace	255.849
Conc.Diamond brace	261.545
Conc. X- Diamond brace	237.479

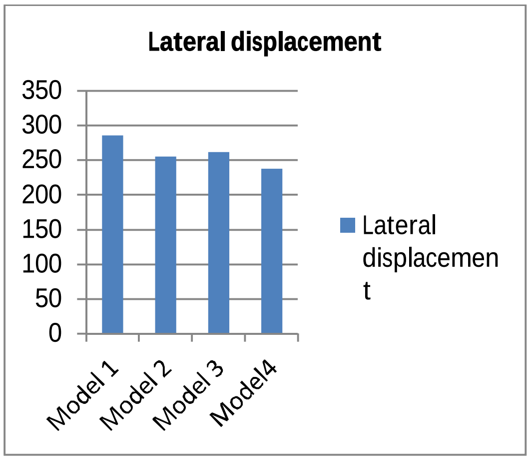


Fig.5 Show maximum joint displacement at top storey in z direction.

The concentric X-Diamond bracing systems have more value of base shear in both direction

B. Base Shear

Models	Base shear (KN)	
	X- Direction	Z-Direction
Model 1	3057.47	2658.27
Model 2	3425.14	2798.29
Model 3	3429.45	2802.37
Model4	3435.34	2802.67

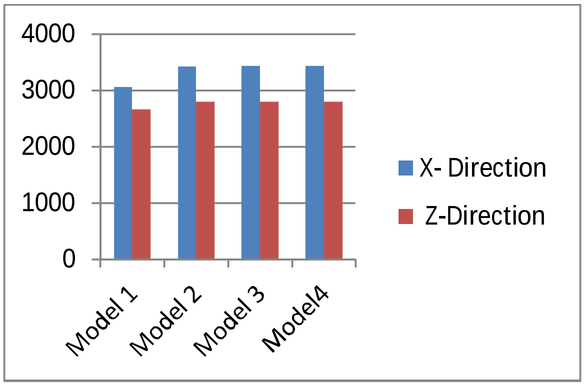


Fig.6 Show maximum base shear in X and Z direction

The base shear of concentric X-Diamond bracing model have least lateral displacement value.

VII. CONCLUSION

A. X and Diamond bracing system have least lateral displacement with respect to storey height when compared to without braced model and other braced models. It reduces its value by 17 %.

B. Concentric x- Diamond bacing system have more base shear, when compared to without braced model and other braced models. It value increased by 11%.

REFERENCES

JOURNALS

[1] Davaran, N.Hoveidae (2009), "Effect of mid connection detail on the behavior of X bracing system."Journal of Constructional Steel Research 65 (2009) 985-990.

[2] A. B. M. Rafiqul Haque, M. Shahria Alam (2017),"Hysteretic behavior of piston based self centering (PBSC) bracing system made of super elastic SMA bars – a feasibility study."Structures 12 (2017) 102–114.

[3] E. Nobahar, M. Farahi, M. Mofid (2016), "Quantification of seismic performance factors of the buildings consisting of disposable knee bracing frames." Journal of Constructional Steel Research 124 (2016) 132-141.

[4] G. Ravi Kumar, S.R. Satish Kumar, V. Kalyanaraman (2007), "Behavior of frames with Non-Buckling bracings under earthquake loading." Journal of Constructional Steel Research 63(2007) 254-262.

[5] M. Maheri, R. Kousari, M. Razazan (2003), "Pushover tests on steel X-braced and knee-braced RC frames." Engineering structures 25 (2003) 1697-1705.

[6] M. Valente (2013), "Seismic protection of R/C structures by a new dissipative bracing system."Procedia Engineering 54 (2013) 785 – 794.

[7] M. Boostani, O. Rezaifar, M. Gholhaki (2018), "Introduction and seismic performance investigation of the proposed lateral bracing system called O Grid."Archives of civil and mechanical engineering 18 (2018) 1024-1041.

[8] M. Speicher, R. DesRoches, R. Leon (2017), "Investigation of an articulated quadrilateral bracing system utilizing shape memory alloys." Journal of Constructional Steel Research 130 (2017) 65–78.

[9] M. Lotfollahi, M. Mofid (2006), "On the design of new ductile knee bracing." Journal of Constructional Steel Research 62 (2006) 282–294.

[10] P Safvana (2018), "Seismic analysis of braced rcc and steel structures using etabs software", International Journal of Recent Scientific Research Vol. 9, Issue, 4(C), pp. 25689-25691, April, 2018.

BOOKS

[1] Duggal, S.K - Limit state design of steel structures.

[2] Sheakar M - Limit state design of steel structures.

IS CODES

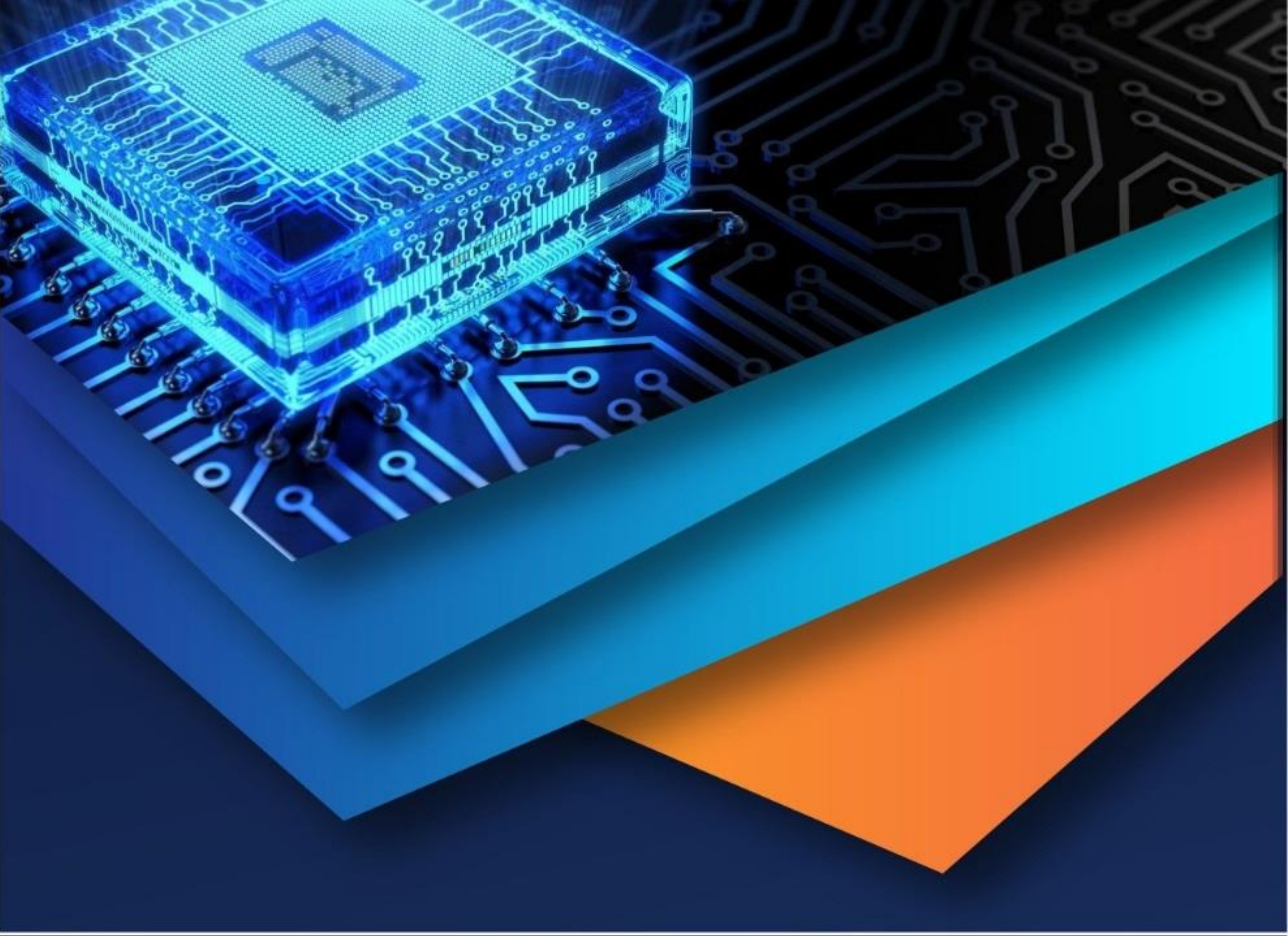
[1] Is : 875 (Part 1) : 1987 Design Loads (Other Than Earthquake) For Buildings And Structures Part-I Dead Loads

[2] Is :875 (Part 2) : 1987 DesignLoads (Other Than Earthquake) For Buildings And Structures Part Ii Imposed Loads.

[3] Is : 875 (Part 3) :1987 DesignLoads (Other Than Earthquake) For Buildings And Structures Part III Wind Loads

[4] Is : 1893(Part 1) : 2016 Criteria For Earthquake Resistant Design Of Structures

[5] Is : 800:2007 General Construction In Steel – Code Of Practice Bureau Of Indian Standards, New Delhi



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