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Contrastive Investigation of Mega Bracing and Different Types of Combination of Bracing

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Abstract: ***Use of bracing for constraining the structure is in trend, so there is need of innovating implicit and coherent bracing system which is able to withstand against lateral forces which will play vital role in design of high rise steel structure. The bracings provide continuous load path and adequate stiffness. If bracing system used in combination then it will perform in accordance to the coalescence .The following probe targets at calculating effect of seismic loading on 18 storey regular bare steel framed building using ETABS software. This buildings adapted different types of combination of bracings such as X&V bracing, V& Chevron bracing, K&X bracing and Megabracing, The ensuing interpretation is done by static equivalent method and Response spectrum method for 18 storey steel framed structure by using analytical software E'Tabs with reference of IS1893:2016 with wind analysis with reference to IS875(part3):2015. Analysis is of each combination of frame is carried out and studied the comparatively studied in terms of lateral displacements, storey shears, storey drifts in different directions. In two methods of analysis results in regular braced models with composite column section and among other, the system which showed better resistance to seismic forces than the other specified bracing systems is interpreted.***

Keywords: High rise Steel structure, Combination of bracing, Megabracing, Etabs, Response Spectrum , static linear, base shear, drift ratio, overturning moment

I. INTRODUCTION

One of the main reason behind the earthquake is due to tectonic activity beneath the earth. This is mainly in the form of P-waves & S-waves, those waves generally last for the short period of time rather for minutes , permanent or for few seconds. But such type of natural disaster cause most collateral damage creating chaos. But specially in case of infrastructural damage the bracing system comes in playing vital role. This waves are majorly travels in all direction from epicentre but for sack infra ,the waves in lateral direction causes the sway moment and vibration in structure.so it's important to building to withstand against such forces with sufficient stiffness, thus steel braced structures are lucid and cost effective solutions to tackle such forces, such system of bracing are easy to assemble and consumes less space but they can be hurdle for architectural perspective but among the all bracing system Megabracing system is newly developed to counter measure such problems.

There are two types of system of bracing are following, Concentric braced system and Eccentrically braced system. CBF are considered one of the economical system of bracing such type of bracing buckle under the compressive force while they tend to yield under tensile action but it is problematic while achieving uniform demand capacity ratio with respect to height of structure. The second most used bracing system is Eccentric Bracing EBS provides efficient resisting system against wind or lateral forces such system can reduce requirement of material but they tends to yield heavily under extreme forces, here the one of the end of brace is connected eccentrically and horizontal forces are transferred by thrusting forces or moment through diagonal bracing or column. The third and recently used in high rise structures type of bracing is Megabracing, MBS can be implemented without hurdle to an working of fundamental use of building the strengthening by such system can be done for long span beams or columns they can give same performance of stiffness and structural rigidity as of concentric or eccentric bracing system. It could be lucrative solution over convention system used in high rise structures and they can be used to improve waler system

II. CURRENT CASE

A. Methodology

These are the following steps involved in methodology

1) Collection of all primary data- such as seismic zone , wind velocity, types of building to be investigated , combination of bracings , types of bracings, references to be used.
2) Problem assessment and Modeling - , it involves assigning orientation of frame, providing properties of materials to be used in structure ,formats of bays in building, size of structural element assigning seismic loads according to IS456:2016 and wind load according to IS875:2015(PartIII)

3) Selection of method- An appropriate method is used for analysis the following two methods is used in investigation
4) Static linear method
5) Response spectrum method or multiple modal analysis or dynamic linear method
6) Expounding of results from observation obtained from software ,Etabs software has been used for investigation Concluding the thesis based on results obtained

B. Modeling and Structural Details

Many software are used over the period of time but use of Etabs provides precise and veracious results .We are using Etabs v.18 as it involves all data from recent revised IS codes. The above research is done on steel structure with 4bays in X direction and 5 bays in Y direction, with each bay of the length of 5m each .The size of plot is 20mX25m having rectangular shape. There is G+18 steel structure with composite column and floor to floor height of 3m. There are five model which is studied and further compared

1) Bare Model of steel rack
2) Combination of V and Chevron bracing
3) Mega bracing
4) Combination of Knee bracing and X bracing
5) Combination of X and Chevron bracing

Table I
Model Specification

Sr.no	Criterion	Specification
1	X dimension	20 m
2	Y dimension	25m
3	No of floors	G+18
4	Soil type	Type II
5	Floor height	3m
6	Zone factor as per IS	0.16
7	Seismic zone	III
8	Importance factor	1.2
9	Damping ratio	5%
10	Reduction factor ‘R’	5
11	Depth of deck slab	75 mm
12	Grade of steel	Fe500
13	Modal period	10 sec
13	Live load	3kN/m.sq
14	Superdead load	4kN/m.sq
15	Accidental eccentricity	0.05
16	Steel structure type	Special MRF
17		

C. Section Details

Column section- composite section of ISLB325 encased with in M40
Secondary beams section-ISLB 250
Bracing section-2ISA130x130x10
The below figure shows the model to be designed and interpreted on software as per IS 1893:2016

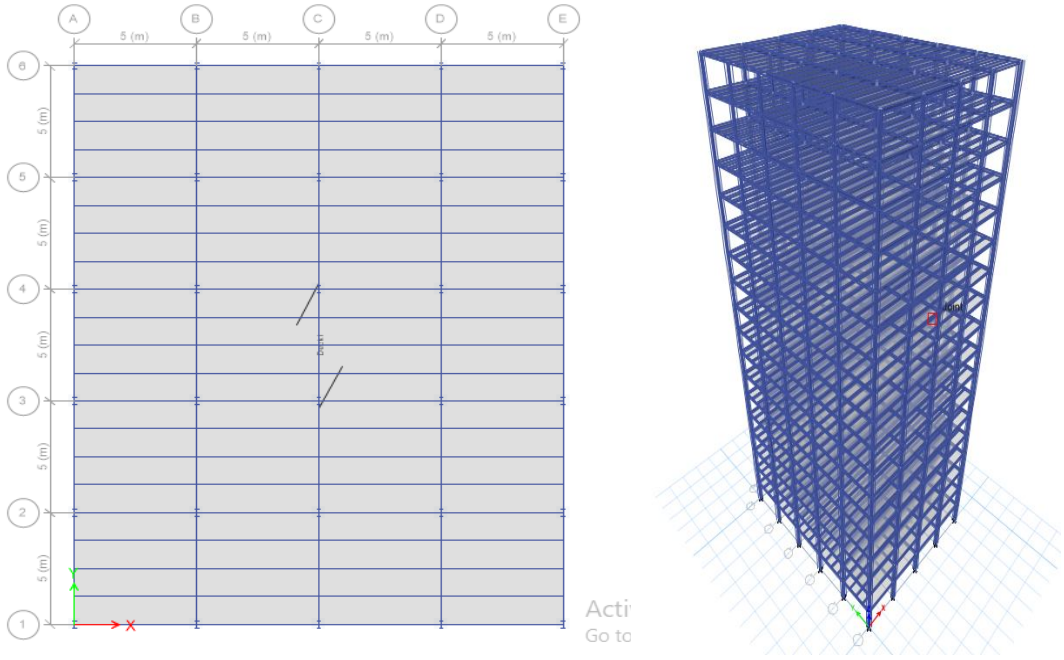

Fig. 1 Plan and 3D view of steel bare frame

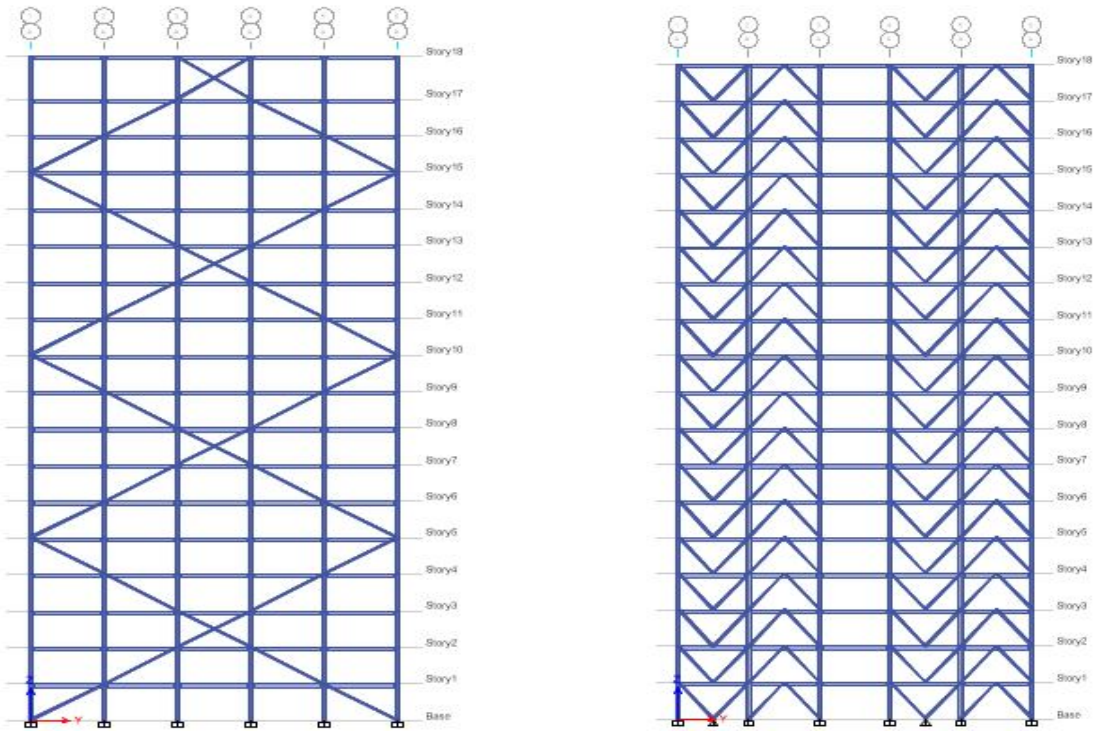

Fig. 2 Elevation of Steel Frame with megabracing and Combination of Chevron and V bracing

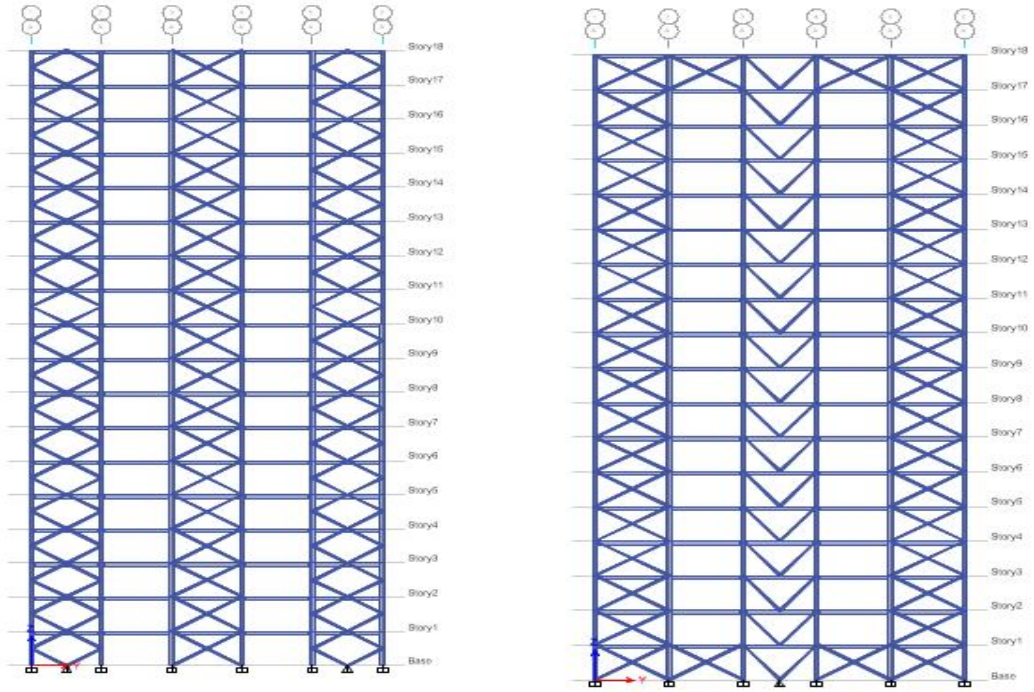

Fig. 3 Combination of X and Knee Bracing & Combination of X and V bracing

III.RESULT AND INTERPRETATION

After evaluating the G+18 steel structures with various combination of bracing and mega bracing under Etabs software by Response spectrum and Static linear or strength based method the correlative judgment has been made with regard to storey drift , storey shifting ,overturning moments in X and Y direction by means of charts and graphs under seismic and wind forces the following graphs and interpretation are made

TABLE IIIII

Overturning moments in X direction

Sr.no	Type of bracing combination	Storey height 'm'	Overturning moment 'kN.m'
1	Megabracing	3	25407
2	Combination of Knee & X bracing	3	24915
3	Combination of V & X bracing	3	24916
4	Combination of V & Chevron bracing	3	24876

The above table IVV represent overturning moment as per IS875:2015(PartIII) along the storey height which same for all models thus variance is less among structures but mega bracing have 1.8%-2% less value than other combination while in Y direction vales of moment are same

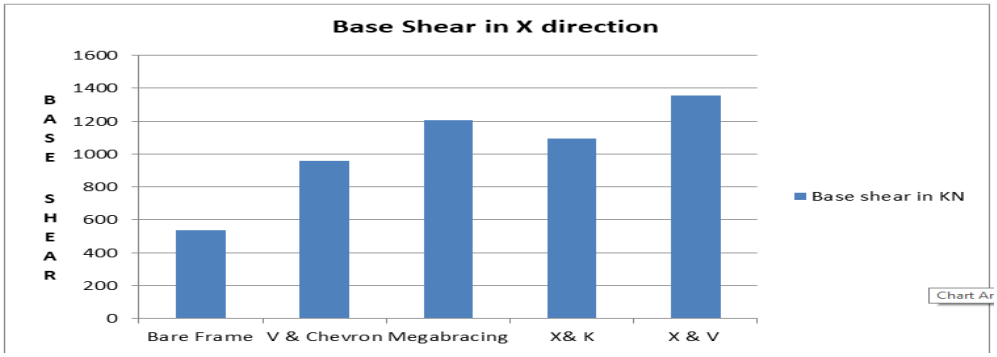

Fig.4 Base Shear in X direction

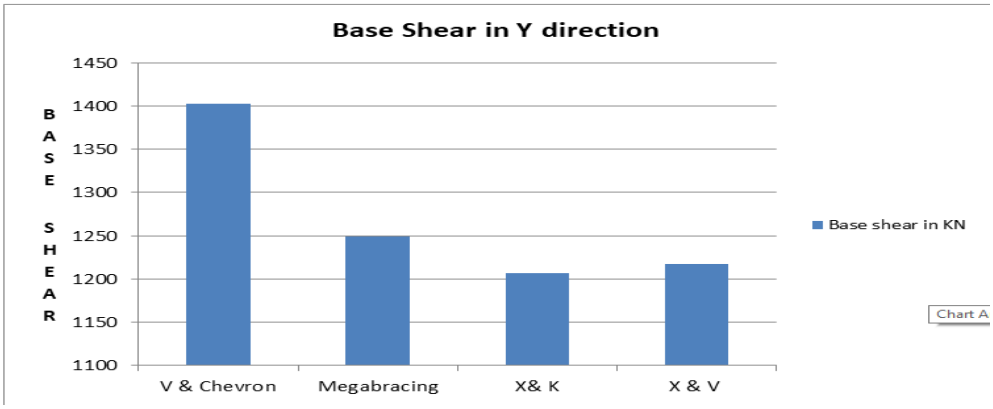

Fig.5 Base Shear in Y direction

The above figure.4 and figure.5 shows base shear in X and Y direction calculated from programe for different combination of bracing ,displayed in comparitive format its show that X &K and X&V bracing worked almost same of eachother in both direction but the large fluctuation can be found base shear of V&Chevron combination in Y direction as compared to X but Megabracing worked more stiffly in both direction X and Y i.e the difference of base shear is 3.76%

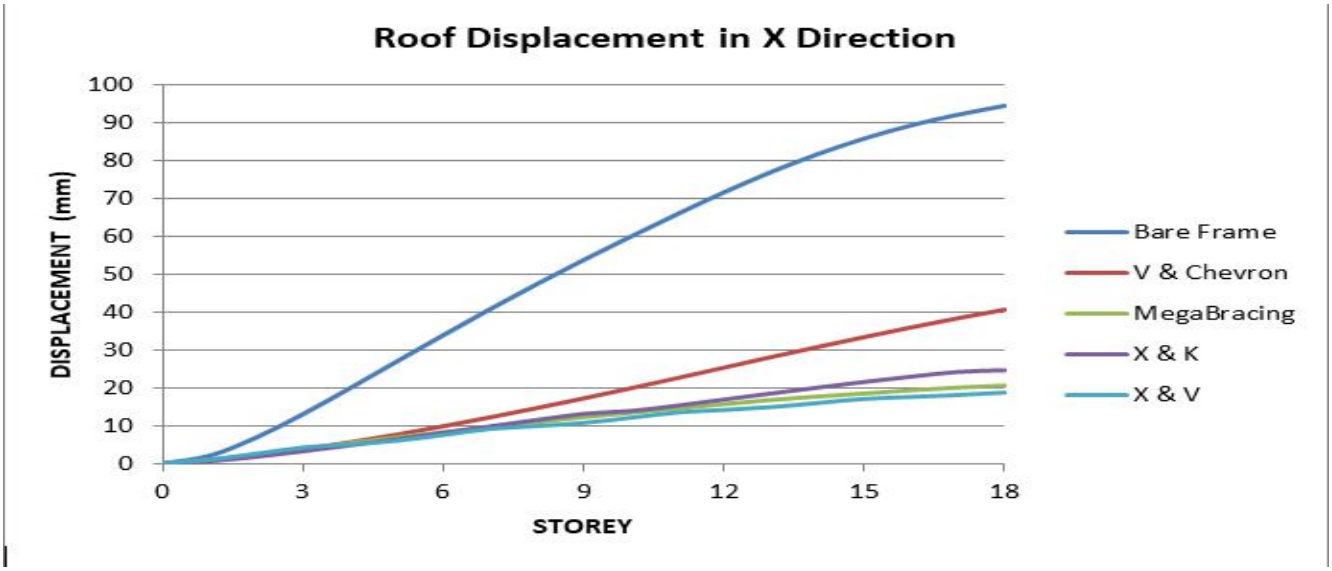

Fig.6 Roof Displacement in X direction

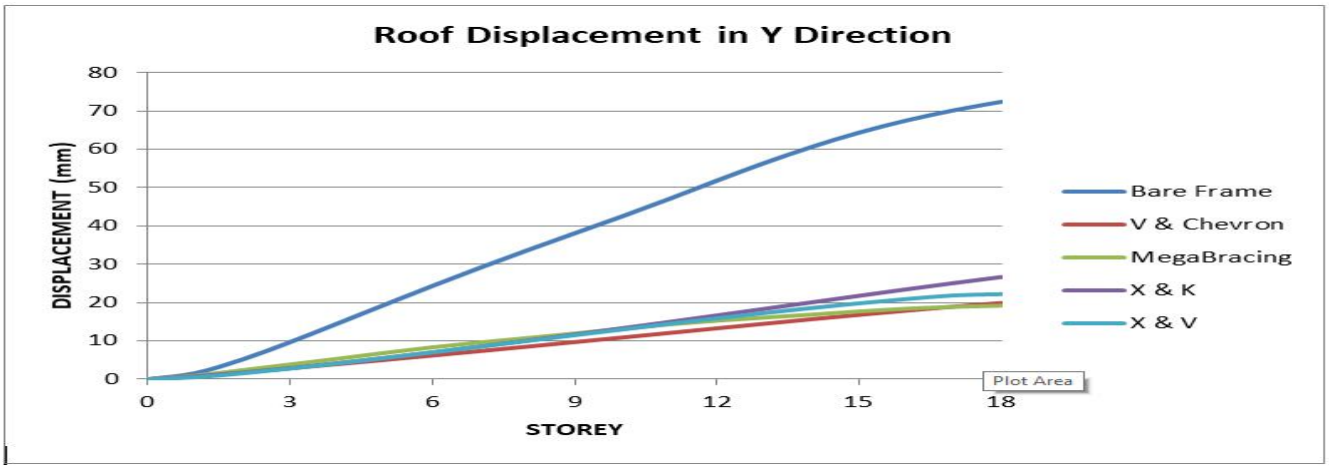

Fig.7 Roof Displacement in Y direction

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Above graphs 7 & 8 shows graph plotted Roof displacement against storey of steel sturcutre in both X and Y direction ,Combinationn of V&Chevron, Megabracing, X&Knee and X&V bracing shows 63%, 77.4%, 75% and 79% respectively restrainment in displacement along storey height as compared to steel strucute with out bracing in X direction while in Y direction Megabracing performed well with with maximum 70.40% reduction but megabrracing provides smooth and continuous graph in both X and Y direction.

Fig.8 Storey drift in X direction

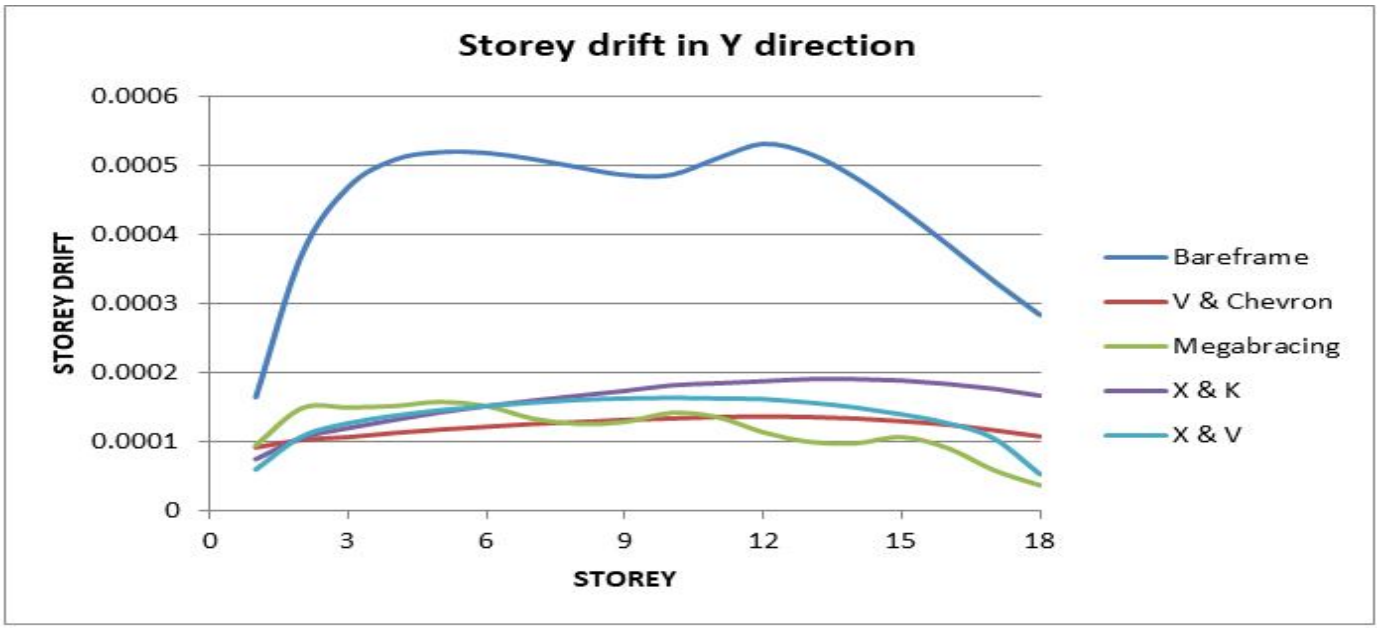

Fig.9 Storey drift in Y direction

Above figure.8 and figure.9 represent the graph of storey drift ratio vs storey number on X and Y axis for different combination of bracing and mega bracing but amongst the all type of combination the mega bracing provide smoothest possible curve in both X and Y direction with minimal drift ratio, out of all types of bracing the combination of X&V bracing show critical path in graph in X direction. Megabracing shows staggering 77.23% reduction in drift ratio as compared to open steel structure without any bracing system while in Y direction it shows 3.21% less drift than combination of V&Chevron bracing, and 26.48%,14.69% more effective than X & Knee, V&X bracing respectively.

IV. CONCLUSIONS

From above analysis and interpretation of results for high rise steel structure with different conjunction of different types of combination of bracing we can conclude following points

A. Megabracing could be more efficient and reliant than other combination of bracing in terms of base shear shows equivalent results in both X and Y direction Megabracing worked more stiffly i.e.3.76% less base shear than bare frame.

B. Variation in roof displacement in case of mega bracing is less as compared to other bracing and it is effective against restraining displacement of roof reducing it upto 70% compared to frame without bracing

C. In terms of drift ratio ,combination of X and V frame shows critical graph lines in x direction while mega bracing shows staggering reduction in drift ratios

D. In case of Overterning moment in all types of bracing performed almost same but megabracing performed with less than 2% values than other combinations

E. Thus, mega bracing could be and costeffective and realiable solution to restraing structure against seismic forces

V. ACKNOWLEDGMENT

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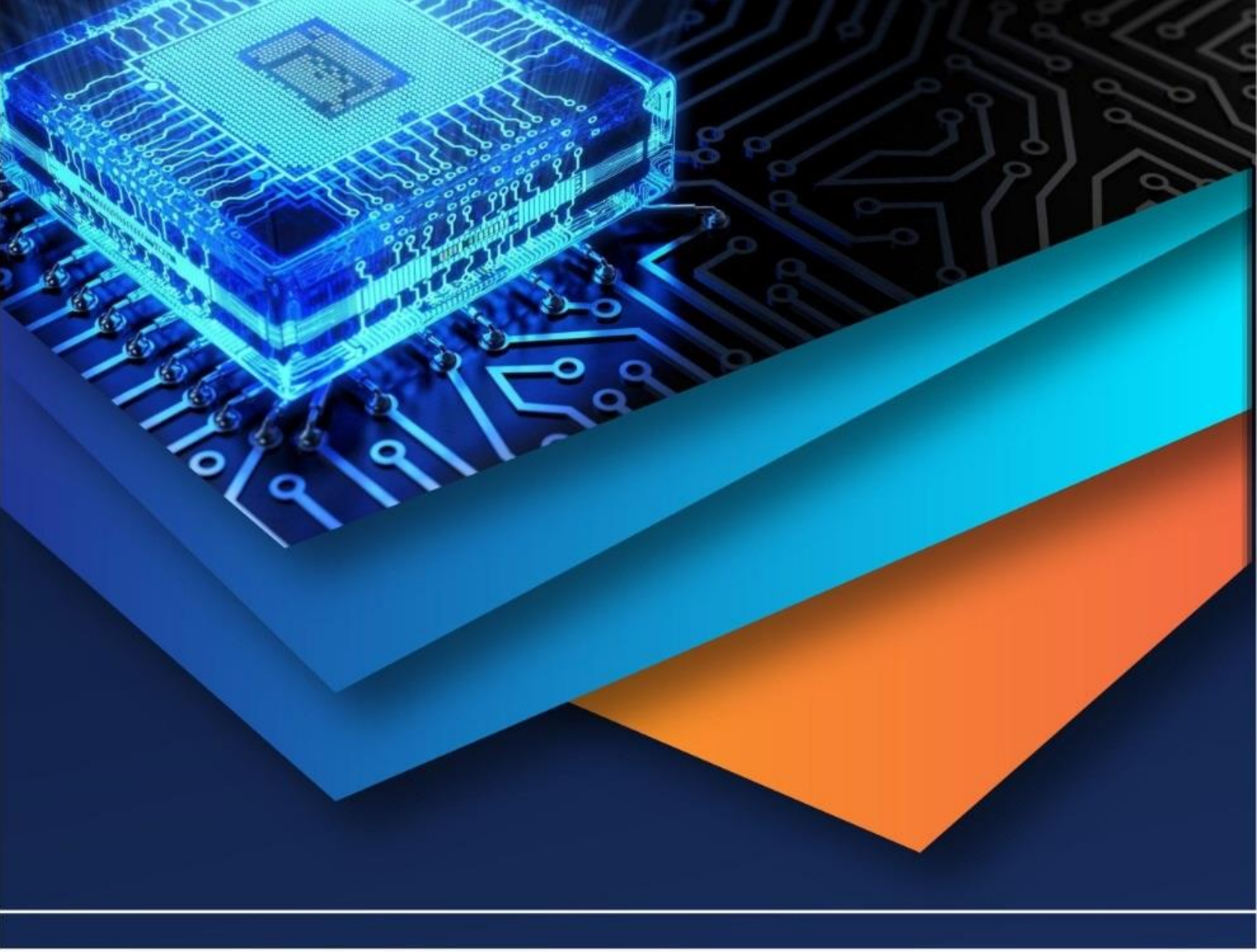

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