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ANALYSIS OF BRACED UNSYMMETRICAL RCC BUILDING USING SAP2000.

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Abstract*—The study of Earthquake Engineering has existence from many years. Earthquake Engineers have made significant contributions to the seismic safety of several important structures in the country. Braced frames, besides other structural systems, such as moment resisting frames or shear walls, have been an effective and valuable method to enhance structures against lateral loads. In seismic excitations, inclined elements react as truss web elements which would bear compression or tension stresses. This axial reaction results in less moments and therefore smaller sizes in beam and column sections with respect to members in similar moment resisting frame. Present analytical seismic study deals with optimum location of steel bracing to the RC structure with unsymmetrical building plan of G+30 stories in Zone 5 following IS 1893(part-1):2002 and IS 13920:1993 by nonlinear dynamic analysis. In this paper two separate Unsymmetrical RCC framed buildings one braced and another general (unbraced) subjected to lateral loads are analyzed. Seismic analysis is carried out using software* SAP2000 V19 *the building is analyzed for different load combinations as per IS 1893:2002. The comparison is done between the braced and unbraced building on the basis of base reactions, joint reactions, and section cut* forces. *It was observed that seismic performance of the braced building is improved as compared to general (unbraced) building.

Keywords: Seismic behavior, RCC Building (G+30), General Building (Unbraced) and Braced building, SAP2000.

I. INTRODUCTION

A. General

In order to design a structure to resist wind and earthquake loads, the forces on the structure must be specified. The exact forces that will occur during the life of the structure cannot be anticipated. Most National Building Codes identify some factors according to the boundary conditions of each building considered in the analysis to provide for life safety. A realistic estimate for these factors is important. During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as Irregular structures. Irregular structures contribute a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes.For example structures with soft storey were the most notable structures which collapsed.Therefore the dynamic analysis is the preferred method for complex structures or structures with irregular geometry. As per IS 1893 (2002) clause 7.8 dynamic analysis can be performed to obtain the design seismic force, to its distribution to different levels along the height of the building. Regular buildings are defined by those greater than 40 m in height in Zones IV and zone V and those greater than 90 m in height in Zones II and III. Irregular buildings are defined by all framed buildings higher than 12m in Zones IV and zone V and those greater than 40m in height in Zones II and III. For irregular buildings less than 40m height, dynamic analysis even though not mandatory.

Braced frame system in the structure consists of truss members as bracing elements. These bracings are commonly used in structures, subjected to lateral loads. They resist lateral forces mainly with the brace members in compression or tension. This makes the bracing system highly efficient in resisting the lateral loads. Also, another reason for the braced frame system to be efficient is, it makes the structure laterally stiff. Based on the types of braces employed in this study, bracing systems are classified depending on whether the braces are connected at column beam joint or away from column beam joint. Braces are grouped into various categories as follows.

BASED ON THE MATERIAL USED IN BRACES:-

a) RCC brace: These are the braces which are made up of reinforced cement concrete. The Cross section of concrete brace is similar to RCC beam or column section. These types of braces are strong in compression but are rarely used because of their construction difficulties and also another disadvantage is, these braces cannot be replaced once damaged due to seismic loads and hence it becomes uneconomical.

Steel brace: In Steel braces different types of steel sections can be used such as channel sections, angle sections, I sections etc or tubular section. These braces usually resist large tension force and fail in buckling. The main advantage of steel braces is it can be replaced after the damage hence making it economical.

BASED ON THE WAY BRACES ARE CONNECTED TO THE FRAME:-

a) Concentric: In a concentrically braced frame bracing members are connected to beam or column junction. Different types of concentric braces can be further classified depending on their configuration. Concentrically braced frames have suitable lateral stiffness to prevent relative drift due to lateral loadimpacts resulting from earthquake. Such braces are part of relatively stiff systems and compatible with common needs of architecture with varied forms. Concentrically braced frames are used in different forms such as cross, diametric and Chevron.

b) Eccentric: In an eccentrically braced frame bracing members are connected to separate points on the beam or column. The segment or link present between beam members help in absorbing energy from seismic activity through plastic deformation. Eccentric Bracings improve the lateral stiffness and increase the energy dissipation capacity. In eccentric connection of the braces to beams, the lateral stiffness of the frame depends upon the flexural stiffness..

Generally, the use of bracings instead of Shear walls provides lower stiffness and resistance for a structure but it should not be forgotten that such a system has lower weight and more useful for architectural purposes. Use of braces for seismic rehabilitation of structures should not cause any torsion disorder and designers should be aware of increasing the axial loads of columns in bracing panels. The probable uplift in columns and foundations should be controlled too.

BASED ON THE BRACES CONFIGURATION:-

a) V brace: Bracing where a pair of braces joins at a single point on the beam span. Inverted V braces that form of chevron bracing that terminates at point on beam from below.

b) X brace: Bracing where two diagonal braces crosses near mid-length of the bracing members.

c) K brace: Bracing where a pair of braces connected on one side of a column joins at a single point on another leg of column.

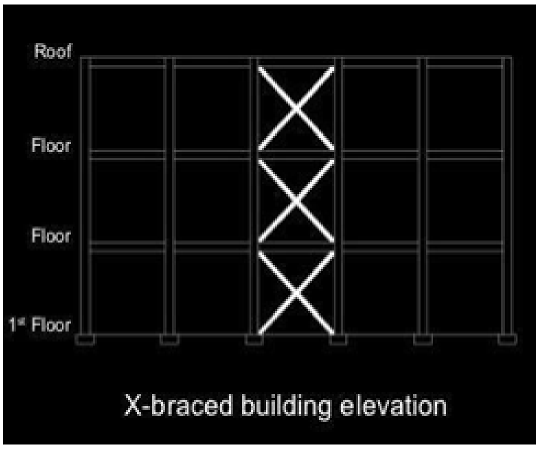


Fig 1: X-braced building elevation.

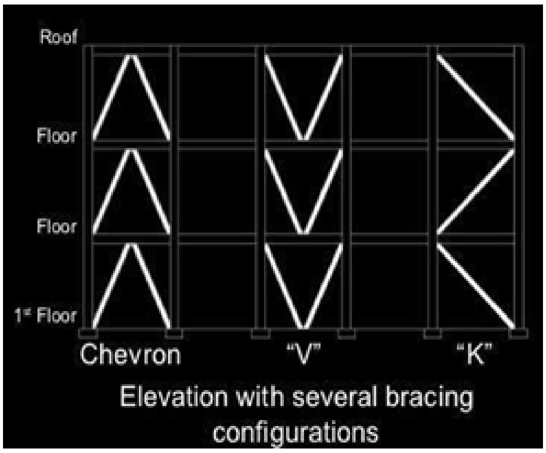


Fig 2: Elevation with several bracing Configurations.

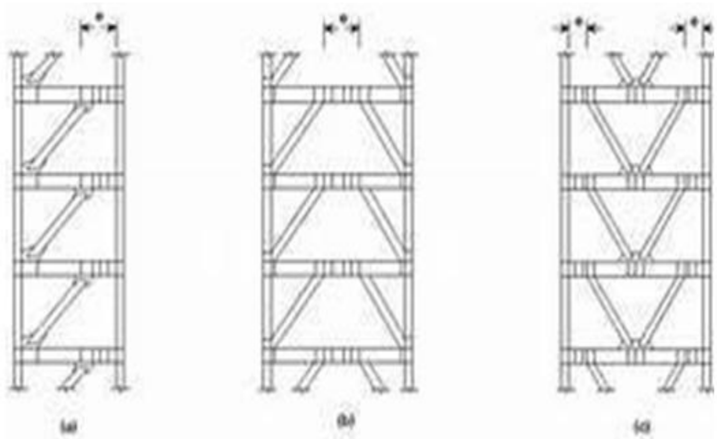


Fig 3: Types of eccentrical bracings.

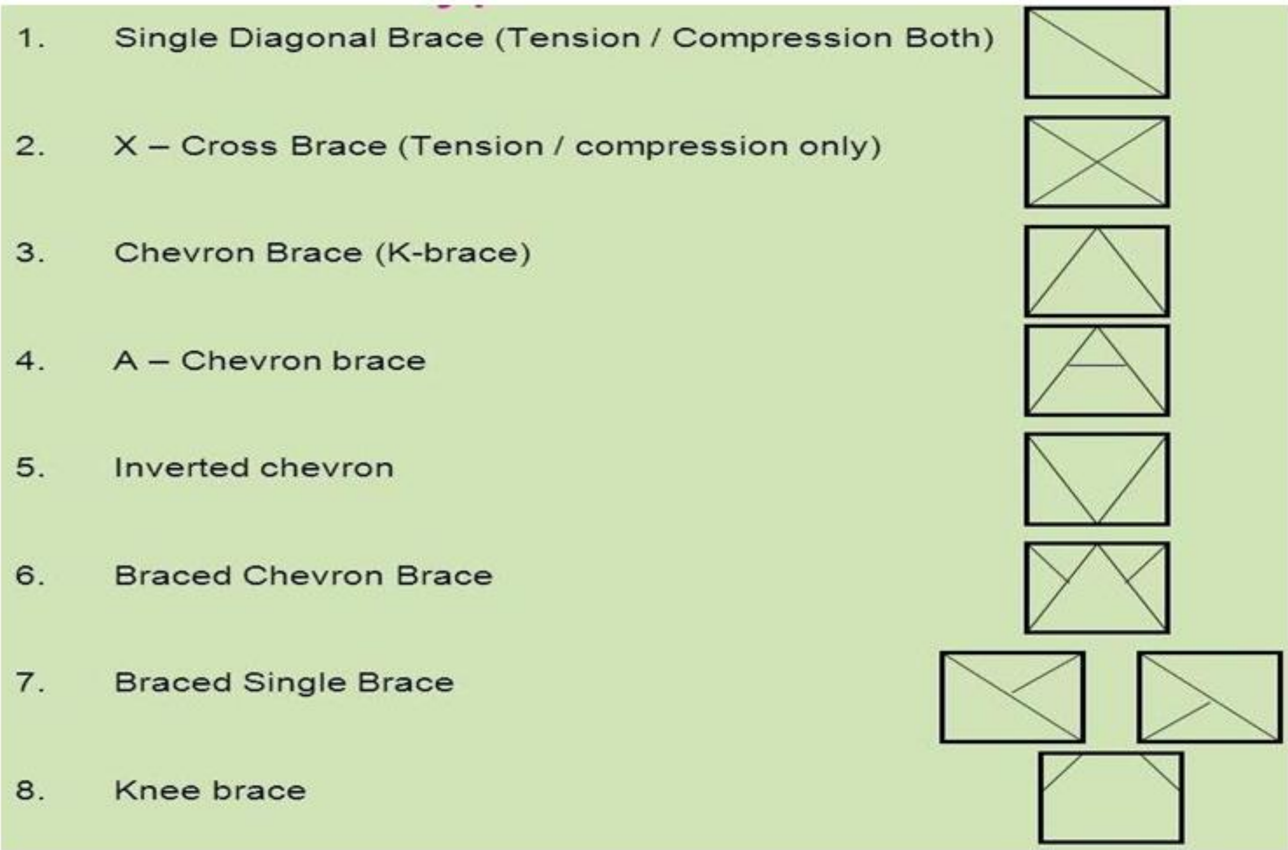


Fig 4: Different types of bracings.

INTRODUCTION ABOUT SAP 2000

SAP2000 represents the most sophisticated and user-friendly release of the SAP series of computer programs. When initially released in 1996, SAP2000 was the first version of SAP to be completely integrated within Microsoft Windows. It features a powerful graphical user interface that is unmatched in terms of ease- of-use and productivity. Creation and modification of the model, execution of the analysis, and checking and optimization of the design, and production of the output are all accomplished using this single interface. A single structural model can be used for a wide variety of different types of analysis and design.

The SAP2000 PLUS program adds unlimited capacity, bridge live-load analysis capabilities, a complete range of finite elements, and time-history analysis options. Ground motion effects with multiple base excitations can be included. The SAP2000 Advanced level extends the PLUS capabilities by adding a nonlinear link element (gaps, hooks, isolators, dampers, and multi-linear plasticity), a multi-linear plastic hinge for use in frame elements, cable behavior, geometric nonlinearity, and frequency-dependent springs.

Analysis capabilities include static nonlinear analysis for material and geometric effects, including pushover analysis; nonlinear time-history analysis by modal superposition or direct integration; buckling analysis; and frequency-domain analysis (both steady-state and power-spectral-density types.) All of the above programs feature powerful and completely integrated design for steel, concrete, aluminum, and cold-formed steel, all available from within the same interface used to create and analyze the model. The design of steel and aluminum frame members features initial member sizing and iterative optimization.

The design of concrete frame members includes the calculation of the amount of reinforcing steel required. Members can be grouped for design purposes, and a single mouse click on an element brings up the detailed design calculations. A wide variety of the latest national and international design codes are supported, and more are being added all the time. Additional add-on modules, which integrate completely within the SAP2000 interface

All SAP2000 data, including model information, analysis results, and design results, can be accessed using a tabular data structure. Tabular data can be edited and displayed in the interface, or exported to a Microsoft Access database file, a Microsoft Excel spreadsheet file, or a simple text file. You can use exported data to create reports or to perform specialized calculations. This same tabular data can be imported into SAP2000, enabling you to generate or modify models outside SAP2000. Import and export capabilities also exist for other popular drafting and design programs.

B. OBJECTIVES OF THE PRESENT STUDY

1. To study the seismic performance of symmetrical building(general building) and un symmetrical building (X braced building) using IS 1893(Part1)-2002.
2. To develop the structure with X type of bracing system.

3. To analyze the structure under static and dynamic loading.
4. To compare the response of the structure under dynamic loading with and without braced structure.

C. SCOPE OF THE STUDY

The present study on bracing systems is limited to high rise multi-storied buildings.

1. Usage of fully steel superstructure and concrete foundation to develop the structural behavior to act on the bracing systems.
2. Various loading cases including equipment loads and other important conditions used for the static as well as dynamic analysis.
3. Nodal displacement at the same node for all the models considered for comparison which determines the response of the bracings.

II. LITERATURE REVIEW

Khatib et al. (1988) studied that the failure mode generally observed in special moment resisting frames with bracing system is fracture of bracings at the locations of local buckling or plastic hinges. Significant story drift can occur at a single story and this research shows how the failure mode occurs and how the failure is concentrated entirely on single floor . So, this is one of the limitations of using moment resisting frames with bracing system.

Seismic response of Steel braced reinforced concrete frames by K.G.Vishwanath in International journal of civil and structural engineering (2010) observed that the four storey building was taken in seismic zone 4 according to IS 1893:2002. The performance of the building is evaluated according to storey drift. Then the study is extended to eight storey and twelve storey. X type of steel bracing is found out to be most efficient.

Akbari et al. (2015) assessed seismic vulnerability of steel X-braced and chevron-braced Reinforced Concrete by developing analytical fragility curve. Investigation of various parameters like height of the frame, the p-delta effect and the fraction of base shear for the bracing system was done. For a specific designed base shear, steel-braced RC dual systems have low damage probability and larger capacity than unbraced system. Combination of stronger bracing and weaker frame reduces the damage probability on the entire system. Irrespective of height of the frame, Chevron braces are more effective than X-type bracing. In case of X-type bracing system, it is better to distribute base shear evenly between the braces and the RC frame, whereas in case of Chevron braced system it is appropriate to allocate higher value of share of base shear to the braces. Including p-delta effect increases damage probability by 20% for shorter dual system and by 100% for taller dual systems. The p-delta effect is more dominant for smaller PGA values.

Chavan, Jadhav(2014) studied seismic analysis of reinforced concrete with different bracing arrangements by equivalent static method using Staad Pro. software. The arrangements considered were diagonal, V-type, inverted V-type and X-type. It was observed that lateral displacement reduced by 50% to 60% and maximum displacement reduced by using X-type bracing. Base shear of the building was also found to increase from the bare frame, by use of X-type bracing, indicating increase in stiffness.

Siddhiqui[1] and Rasheed Hameed[2] et and all,. (2014) studied five different types of bracing systems and investigated for the use in a tall building in order to provide lateral stiffness and finally the optimized design in terms of lesser structural weight and lesser lateral displacement. A sixty storey regular shaped building is selected and analyzed for wind gravity loading. Lesser structural steel weight of a tall building is obtained when it is braced along the minor axis of bending of columns in comparison of the situation when same building is braced along the major axis of bending. Among five different investigated bracing systems, double bracing system yields minimum weight of structural steel. When columns were braced along their minor axis of bending, provision of K bracing results in minimum value of lateral displacements compared to other types of bracing systems.

When the columns are braced along the major axis, although lateral displacement values goes beyond the permissible limits but among the five types of bracing systems, which similar to the case when columns are braced along the minor axis of bending. K type bracing results in smaller lateral displacement compared to other types. The double bracing provided in the central bays along the minor axis of bending of columns of a tall building yields minimum weight of the structure. For bracing against lateral wind loads, double bracing system was suggested.

III. PROBLEM FORMULATION

The structures are acted upon by different loads such as dead load (DL), Live load and Earthquake load (EL).

A. Self-weight of the structure comprises of the weight of the beams, columns and slab of the structure.

B. Dead load of the structure according to (IS875(Part1)).

- Dead load for column: unit weight of concrete X thickness of column X width of the wall = 24KN/m^3 X 0.6m X 0.6m=8.64KN/m.
- Dead load for beam: unit weight of concrete X thickness of beam X width of the beam = 24KN/m^3 X 0.4m X 0.4m=3.84KN/m.

C. Live load: It consists of Floor load which is taken as 3.5KN/m^2, according to (IS 875 (Part2).

D. Seismic Load: The different seismic parameters are taken as follows, IS1893(Part-1):2002.

- Seismic zone: V (Z=0.36)..
- Importance factor:1
- Damping: 5%.

IV. RESEARCH METHODOLOGY

A. Plan Details

In building the plan was taken in seismic zone V for seismic analysis of the building (G+30) with columns spaced at 3m from center to center. The storey height is kept as 3m. Basically model consists of multiple bay thirty storeys building, each bay having width of 3m. The storey height between two floors is 3.0m with column sizes of 0.6x0.6m and beam size of 0.4x0.4m respectively and also the slab thickness is taken as 0.125m.

The material Properties and Geometry of the model are described below.

1) Length X width: 35.2 m x 32.25 m
2) Number of stories:31
3) Support conditions: Fixed
4) Storey height: 3m
5) Grade of concrete: 30MPa
6) Grade of steel:Fe415
7) Size of columns from all storey: 600mm x 600mm
8) Size of beams: 400mm x400mm.

Shape of the building for all the cases is shown in figure. Shape of the building includes plan, elevation, and 3D- view for the both unsymmetrical unbraced building (general building) and unsymmetrical braced building.

Fig No. 5, 6 and 7 shows the plan, elevation, and 3D-view of the unsymmetrical unbraced building (general building).

Fig No. 8, 9 and 10 shows the plan, elevation, and 3D-view of the unsymmetrical braced building.

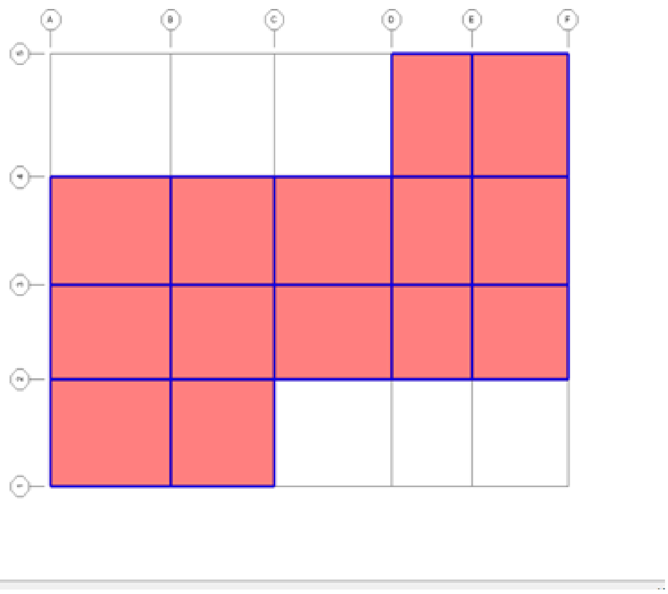


Fig No: 5 **PLAN**

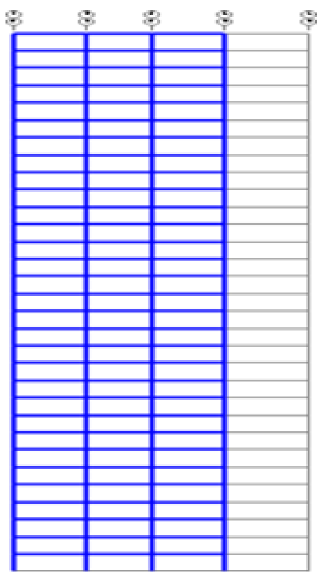


Fig No: 6 **ELEVATION**

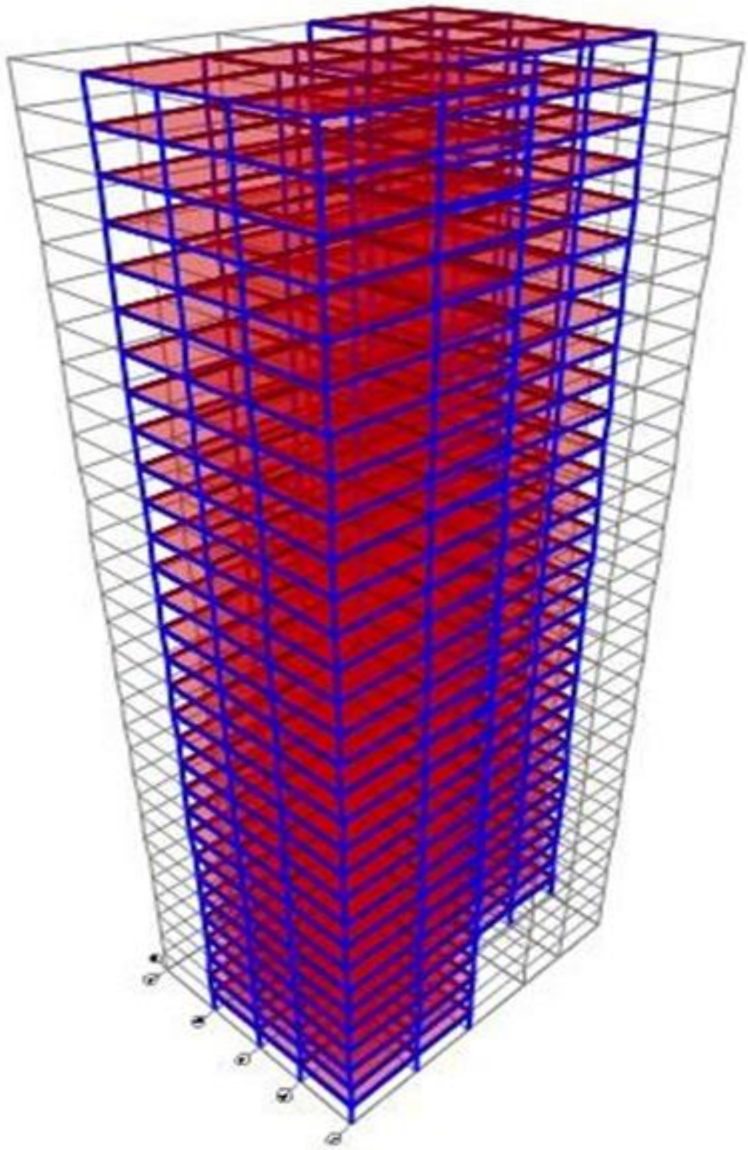
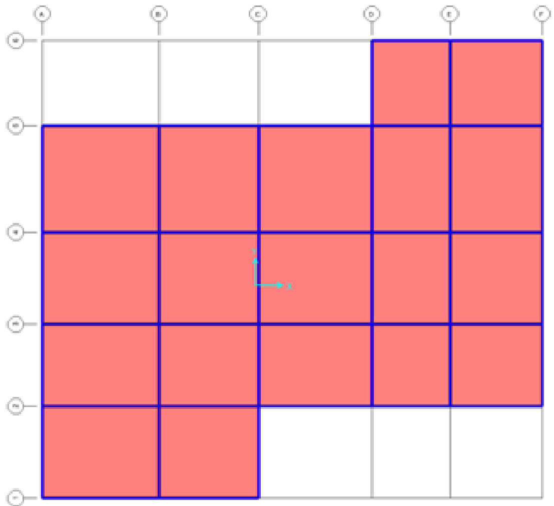


Fig No: 7 **3D VIEW**

UNSYMMENTRICAL UNBRACED BUILDING (GENERAL BUILDING) PLAN VIEW



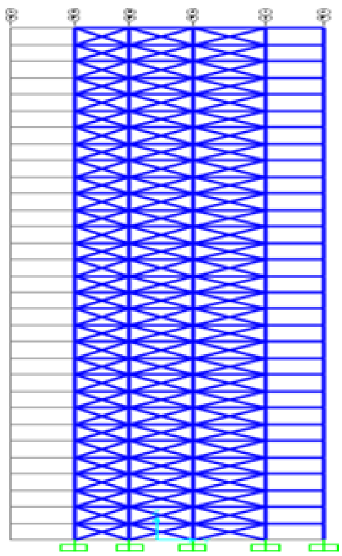


Fig No: 8 **PLAN**

Fig No: 9 **ELEVATION**

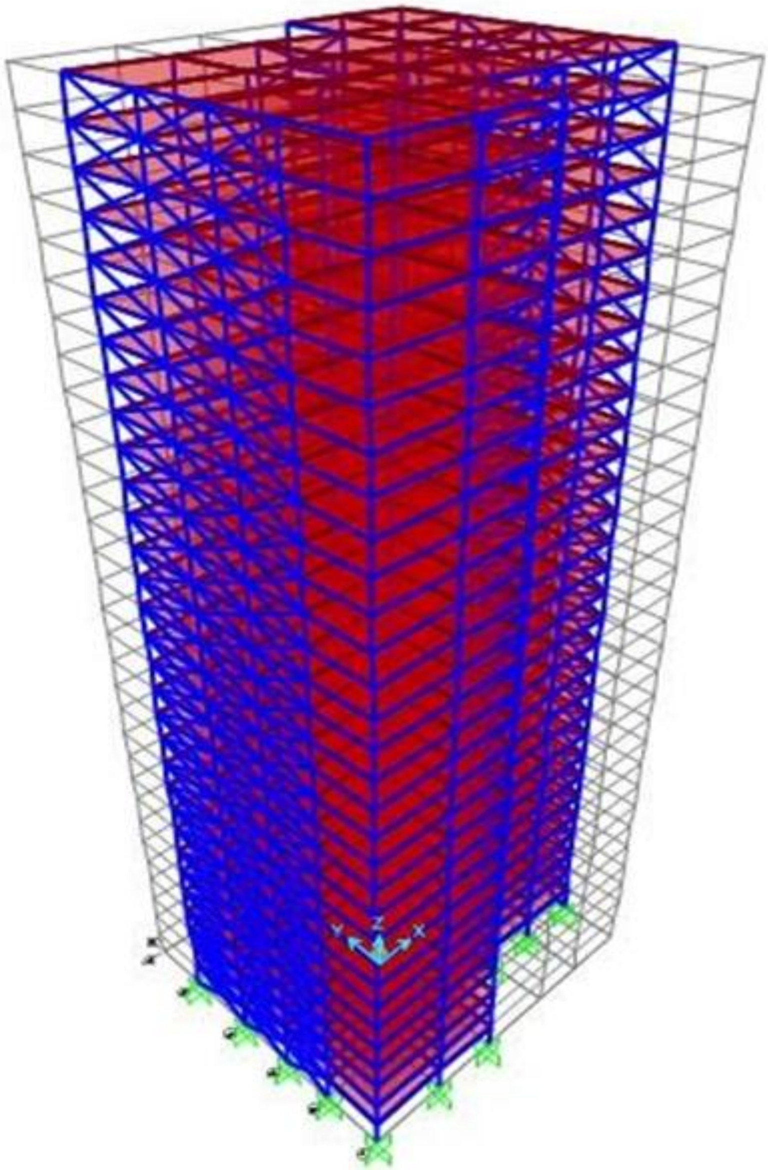


Fig No: 10 3DVIEW
UNSYMMENTRICAL BRACED BUILDING PLAN VIEW

V. RESULTS AND ANALYSIS

BASE REACTIONS

The base reactions obtained for both general building and braced building are presented in following tables

TABLE 1: FORCES IN X-DIRECTION

OUTPUT CASE	GENERAL BUILDING	BRACED BUILDING
	GLOBAL FX KN	GLOBAL FX KN
DEAD	-768	-960
LIVE	3.96E-09	-8.52E-10
EQX	-24546.76	-2.84E-10
EQY	2.37E-07	-8096.214
WINDX	0	-2.27E-11
WINDY	0	0
FF	0	0

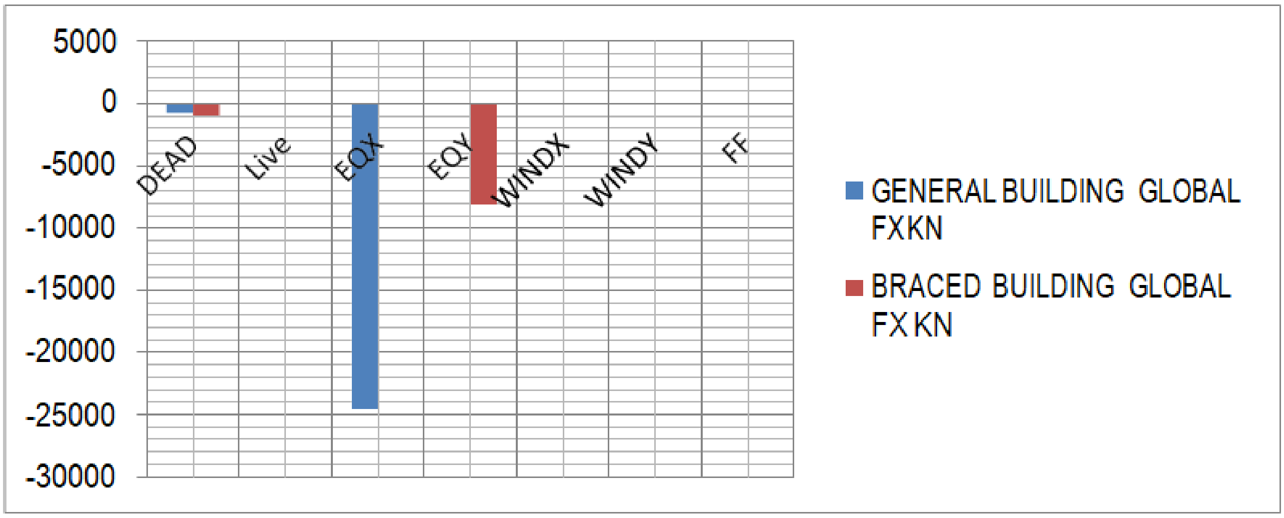


Fig No: 11 The base reactions (forces) obtained for both general building and braced building in x-direction. From the fig no.11 the dead load and live load is maximum in braced building global FX than the general building global FX.The earthquake (EQ X) of general building global force FX is maximum in negative direction in and (EQ Y) of braced building global force FX is also maximum in negative direction. The wind x and wind y is zero for both the general building and braced building and floor finish is also zero for the both cases. For both the analyses, it can be concluded that by increasing the bracing, or by increasing the lateral stiffness shear force in columns tend to decrease. The value of maximum base shear increases in braced structure as compared to general building is due to increased stiffness of building by addition of braced member

TABLE 2: FORCES IN Y-DIRECTION

OUTPUT CASE	GENERAL BUILDING	BRACED BUILDING
	GLOBAL FY KN	GLOBAL F Y KN
DEAD	-768	-960
LIVE	-4.14E-10	-1.63E-10
EQX	2.02E-07	-5.40E-11
EQY	-24546.76	2.15E-09
WINDX	0	-8096.214
WINDY	0	0
FF	0	0

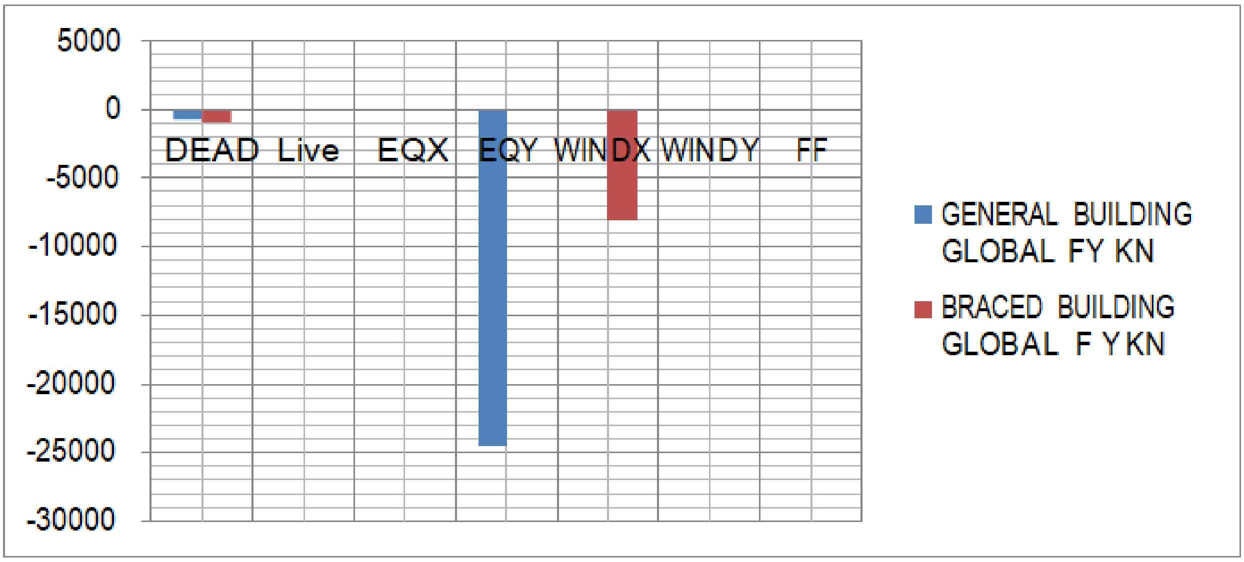


Fig No: 12 The base reactions (forces) obtained for both general building and braced building in x-direction. From the fig no.12 the dead load and live load is maximum in braced building global FY than the general building global FY. The earthquake (EQ Y) of general building global force FY is maximum in negative direction as compared to braced building. The wind x is maximum in braced building in negative direction as compared to general building and wind y is zero for both the general building and braced building and floor finish is also zero for the both cases. The value of maximum base shear increases in braced structure as compared to general building is due to increased stiffness of building by addition of braced member

TABLE 3: FORCES IN Z DIRECTION

OUTPUT CASE	GENERAL BUILDING	BRACED BUILDING
	GLOBAL FZ KN	GLOBAL FZ KN
DEAD	240182.01	330047.255
LIVE	76880	80538
EQX	-9.48E-10	26846
EQY	-2.29E-09	26846
WINDX	0	26846
WINDY	0	0
FF	0	0

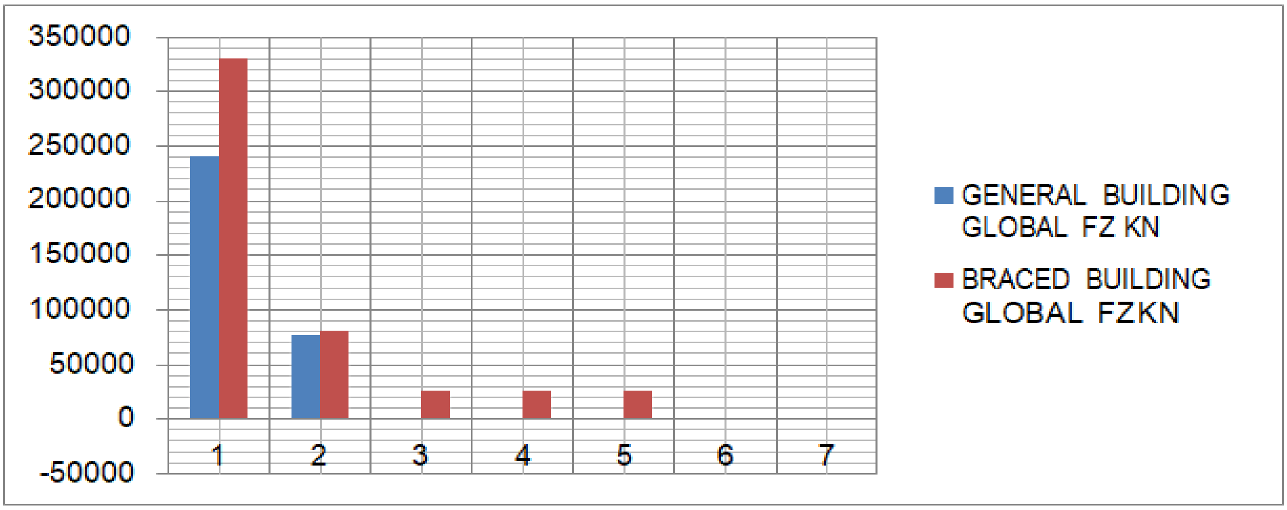


Fig No: 13 The base reactions (forces) obtained for both general building and braced building in z-direction. From the fig no.13 it is concluded that the dead load and live load is maximum in braced building global FZ than the general building global FZ.The earthquake EQ X is maximum in braced building global FZ as compared to general building and EQ Y is also maximum in braced building global FZ as compared to general building. In general building wind x is zero and wind y for both the general building and braced building is zero and floor finish is also zero for the both cases. For both the analyses, it can be concluded that by increasing the bracing, or by increasing the lateral stiffness shear force in columns tend to decrease. The value of maximum base shear increases in braced structure as compared to general building is due to increased stiffness of building by addition of braced member

TABLE 4: MOMENTS IN X DIRECTION

OUTPUT CASE	GENERAL BUILDING	BRACED BUILDING
	GLOBAL MX KN- m	GLOBAL MX KN- m
DEAD	1618272.2	358505.37
LIVE	504680	76353
EQX	-1.19E-05	25451
EQY	1298208.9	25451
WINDX	0	598047.85
WINDY	0	0
FF	0	0

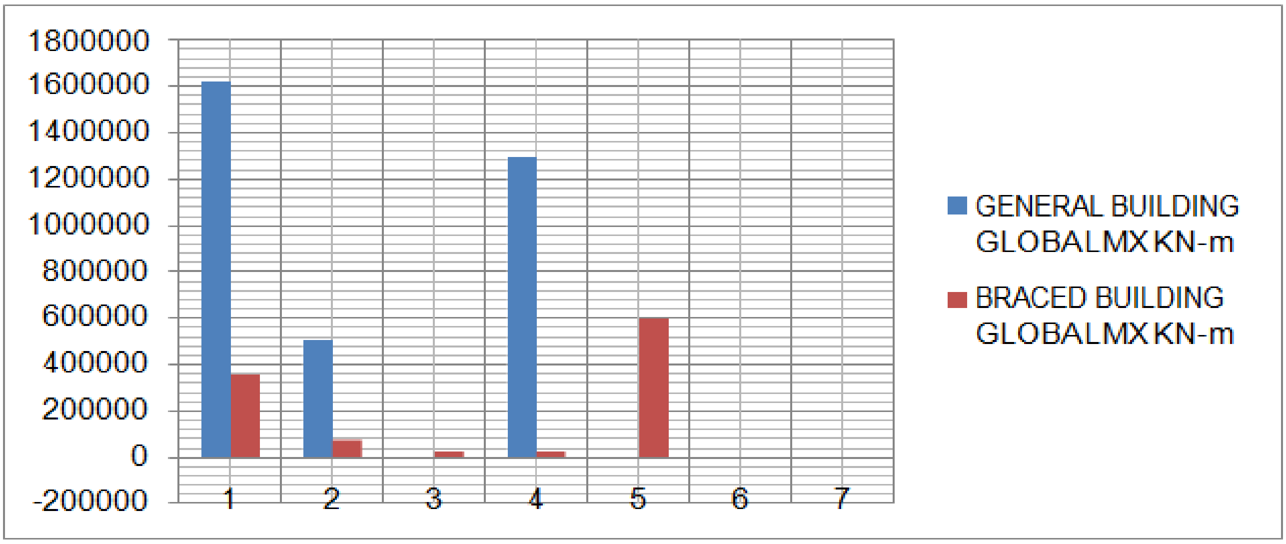


Fig No:14 The base reactions (moments) obtained for both general building and braced building in x-direction. From the fig no.14 it is observed that the dead load and live load is maximum in general building global MX as compare to braced building global MX. The earthquake EQ X for general building is zero and for braced building it has in positive direction .EQ Y is maximum in general building global MX than the braced building global MX.The wind x in general building is zero and for braced building it has in positive direction and wind y is zero for both the general building and braced building and floor finish is also zero for both the general and braced building. So, by increasing the lateral stiffness of the moment resisting frame, increasing the bracing bending moment force applied at the columns tend to decrease. By providing braces in the frame, the horizontal load at node is distributed among brace members along with beams and columns.

TABLE 5: MOMENTS IN Y DIRECTION

OUTPUT CASE	GENERAL BUILDING	BRACED BUILDING
	GLOBAL MY KN- m	GLOBAL MY KN- m
DEAD	-2534149	-934903.3
LIVE	-783432	-195188.4
EQX	-1298209	-65062.8
EQY	1.43E-05	-637659.7
WINDX	0	-65062.8
WINDY	0	0
FF	0	0

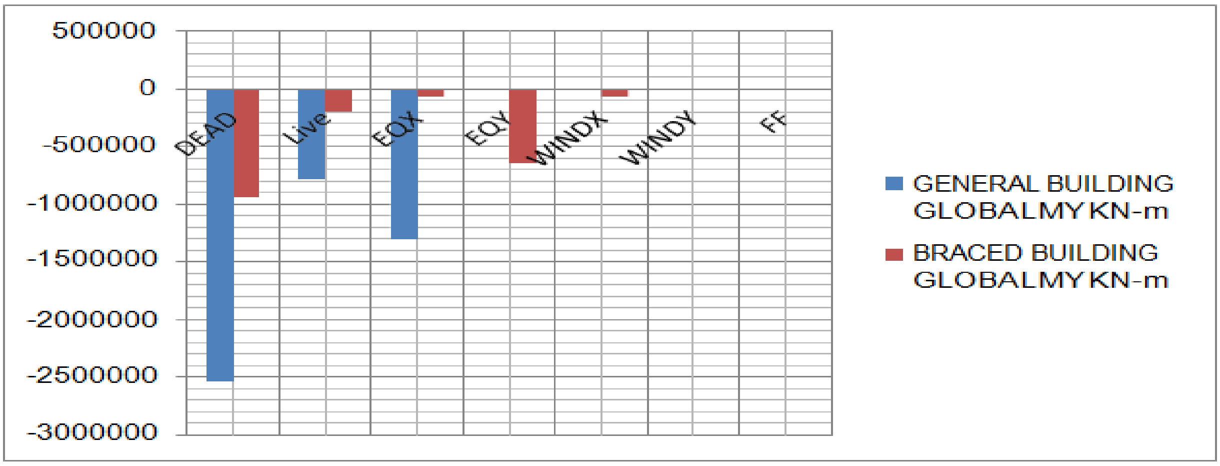


Fig No:15 The base reactions (moments) obtained for both general building and braced building in y-direction.
From the fig no.15 it is observed that dead load and live load is maximum in general building global MY than the braced building global MY. The earthquake (EQ X) is maximum in general building global MY than the braced building global MY in negative direction and EQ Y is also maximum in negative direction. The wind x in general building is zero and for braced building it has in negative direction and wind y and floor finish is zero for both the general and braced building. So,

by increasing the lateral stiffness of the moment resisting frame, increasing the bracing bending moment force applied at the columns tend to decrease. By providing braces in the frame, the horizontal load at node is distributed among brace members along with beams and columns. Due to arrangement of the bracing system in the building bending moment comparatively reduces.

TABLE 6: MOMENTS IN Z DIRECTION

OUTPUT CASE	GENERAL BUILDING	BRACED BUILDING
	GLOBAL MZ KN- m	GLOBAL MZ KN- m
DEAD	-4040	-3304
LIVE	-1.22E-08	1.21E-08
EQX	161312.86	4.02E-09
EQY	-251092.7	7720.3429
WINDX	0	-21263.08
WINDY	0	0
FF	0	0

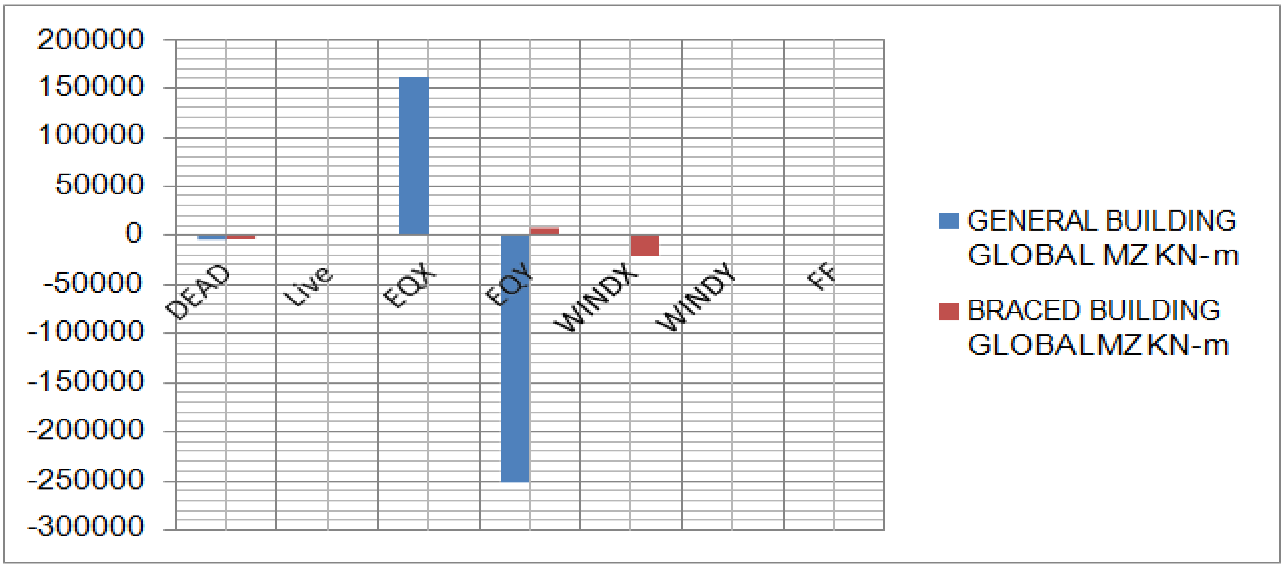


Fig No: 16 The base reactions (moments) obtained for both general building and braced building in z-direction.

From the fig no.16 it is observed that dead load is maximum in general building global MZ than the braced building global MZ. The earthquake EQ X is maximum in general building global MZ than the braced building global MZ and EQ Y is also maximum in negative direction. Wind X, Wind Y and floor finish is zero for both the general and braced building. So, by increasing the lateral stiffness of the moment resisting frame, increasing the bracing bending moment force applied at the columns tend to decrease.

JOINT REACTIONS

The joint reactions obtained for both general building and braced building are presented in following tables.

TABLE 7: FORCES IN BOTH GENERAL AND BRACED BUILDS

JOINT TEST	OUTPUT CASE	GENERAL BUILDING			BRACED BUILDING		
		F1 KN	F2 KN	F3 KN	F1 KN	F2 KN	F3 KN
1	DEAD	7.054	-0.503	6934.852	-10.949	24.852	7498.16
1	LIVE	14.302	10.369	2042.587	-1.692	6.438	1647.12
1	EQX	-833.498	-8.454	-6378.06	-0.564	2.146	549.04
1	EQY	4.75	-919.533	-9636.45	-96.53	-3.248	-702.823
1	WINDX	0	0	0	6.765	-59.013	-1488.88
1	WINDY	0	0	0	0	0	0
1	FF	0	0	0	0	0	0

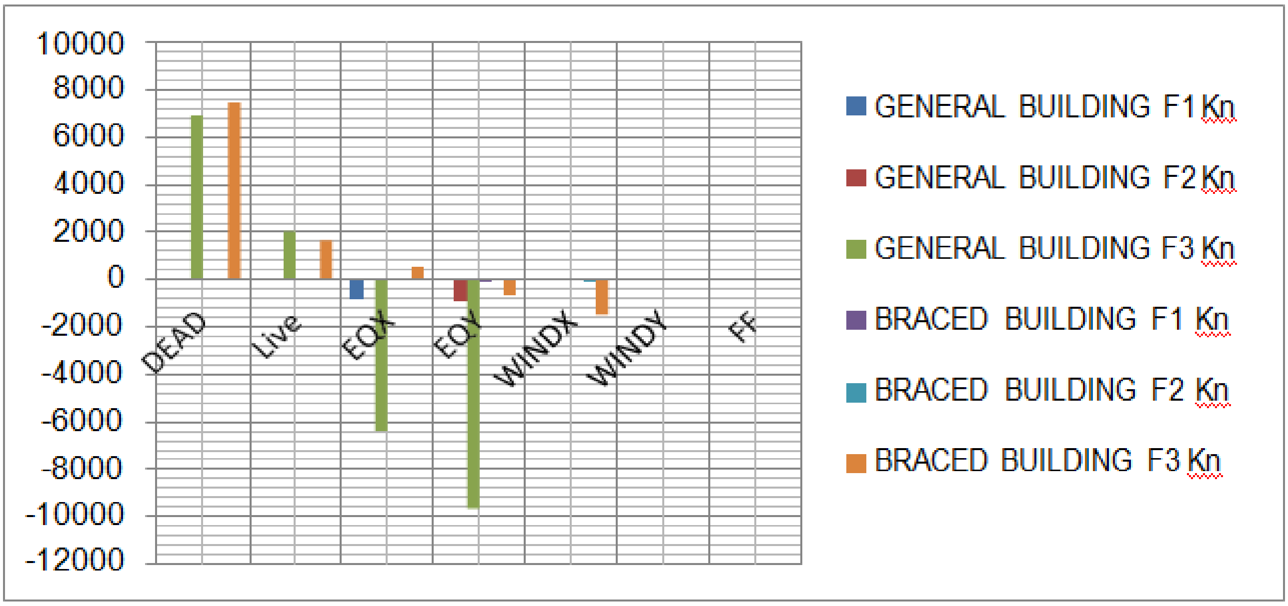


Fig No: 17 The joint reactions (forces) obtained for both general building and braced building.

From the fig no.17 it reflects that the values of dead load in braced building F3 shows greater values than the general building F3. The live load in the general building F3 shows greater values than the braced building F3.The earthquake EQ X in braced building shows greater values than the general building.EQ Y for general buildings braced building F3 shows greater values than the braced building in negative direction.The wind x and wind y for braced buildings braced building F3 shows greater values than the general building in negative direction. The floor finish for general building and for braced building is zero.

TABLE 8: MOMENT FORCES IN BOTH GENERAL AND BRACED BUILDING

JOINT TEST	OUTPUT CASE	GENERAL BUILDING			BRACED BUILDING		
		M1 KN-m	M2 KN-m	M3 KN-m	M1 KN-m	M2 KN-m	M3 KN-m
1	DEAD	58.4242	-65.312	-1.5885	-39.151	-42.0285	-3.3816
1	LIVE	-9.478	14.4401	0.0379	-11.5019	-3.086	-0.5611
1	EQX	-31.064	-3077.48	0.2182	-3.834	-1.0287	-0.187
1	EQY	3214.589	77.0165	4.1119	3.7503	-305.617	0.4124
1	WINDX	0	0	0	152.5275	12.632	0.7262
1	WINDY	0	0	0	0	0	0
1	FF	0	0	0	0	0	0

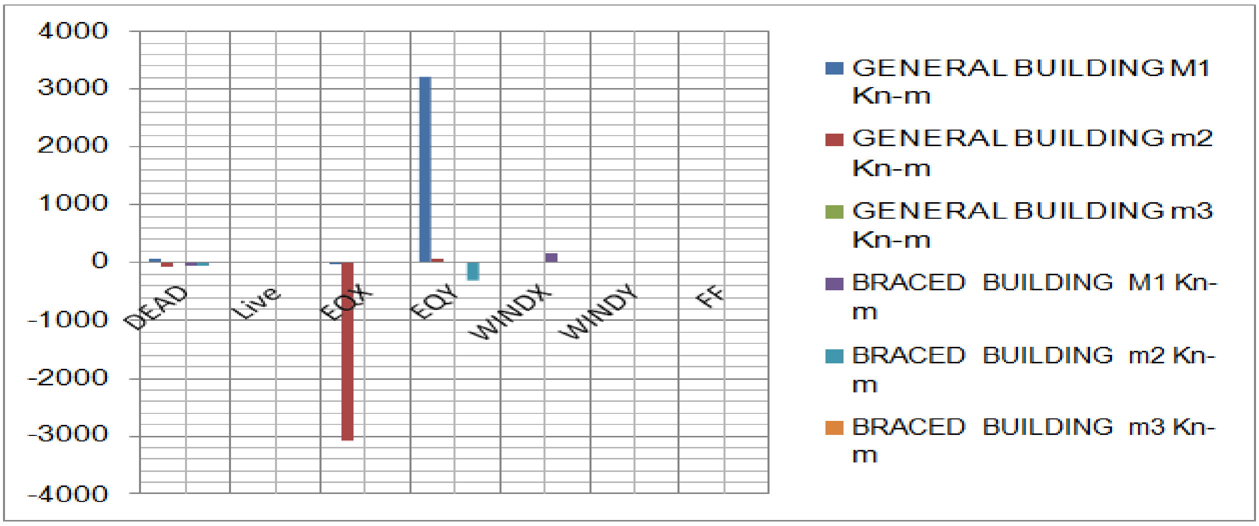


Fig No: 18 The joint reactions (moments) obtained for both general building and braced building.

From the fig no.18 it reflects that the values of dead load in general building M1 shows greater values than the braced building M1 but the values of dead load in general building M2 shows greater values than the braced building M2.. The live load in the braced building M1 shows greater values than the general building M1 but the values of live load in general building M2 shows greater values than the braced building M2.The earthquake EQ X in braced building shows greater values than the general building.EQ Y for general buildings shows greater values than the braced building. The wind x for braced building shows greater values than the general building and wind y is zero for both general and braced building. . The floor finish for general building and for braced building is zero.

SECTION CUT FORCES

The section cut forces obtained for both general building and braced building are presented in following tables.

TABLE 9: FORCES (F1, F2, F3.)

SECTION CUT TEXT	OUTPUT CASE	GERENAL BUILDING			BRACED BUILDING		
		F1 KN	F2 KN	F3 KN	F1 KN	F2 KN	F3 KN
SCUT1	DEAD	8.90E-09	2.63E-08	240950	-1.71E-09	2.42E-10	331007.3
SCUT1	LIVE	-1.17E-10	-3.82E-09	76880	-2.23E-10	-1.33E-10	80538
SCUT1	FF	1.87E-07	21638.35	-1.45E-10	-6.66E-11	-2.53E-11	26846
SCUT1	EQX	-21638.4	-2.29E-07	2.33E-10	1.25E-09	4.90E-09	26846
SCUT1	EQY	0	0	0	-1.78E-08	-4.27E-10	26846
SCUT1	WINDX	0	0	0	0	0	0
SCUT1	WINDY	0	0	0	0	0	0

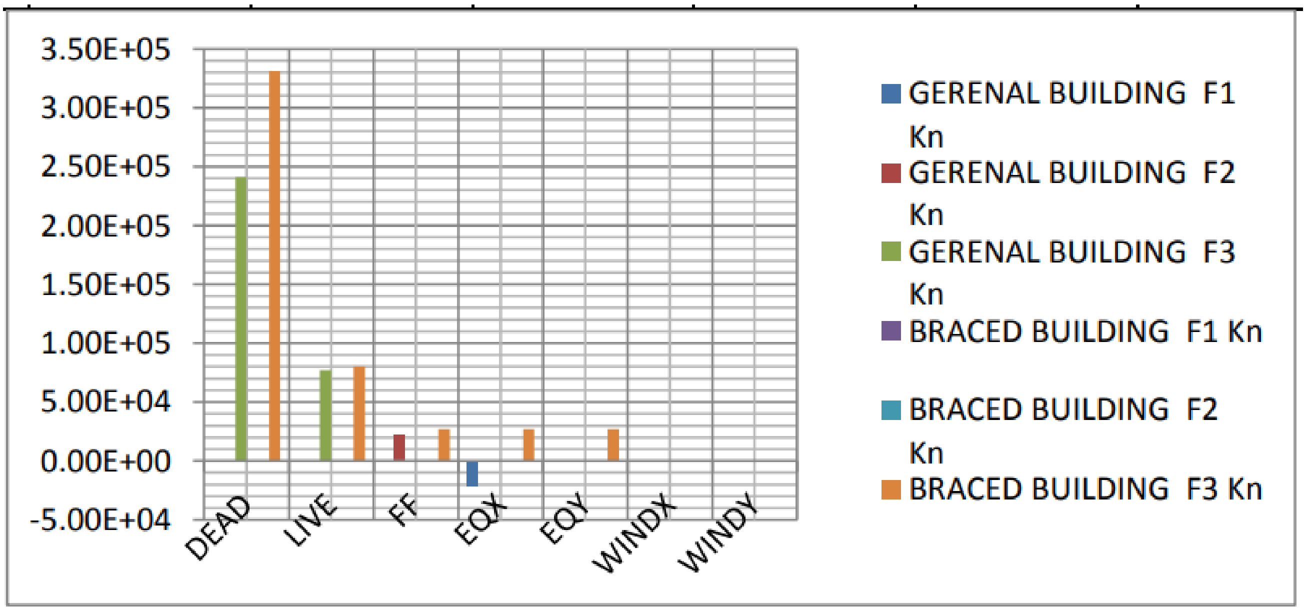


Fig No: 19 The section cut (forces) obtained for both general building and braced building.

From the fig no.19 it reflects that the values of dead load in braced building F3 shows greater values than the general building F3. The live load in the braced building F3 shows greater values than the general building F3. The floor finish in braced building F3 shows greater values than the general building F2.The earthquake EQ X in braced building shows greater values than the general building.EQ Y for general buildings is zero where as for braced buildings EQ Y has positive values. The wind x and wind y are zero for both general and braced building. The value of maximum base shear increases in braced structure as compared to general building is due to increased stiffness of building by addition of braced member.

TABLE 10: MOMENTS (M1, M2, M3.)

SECTION CUT TEXT	OUTPUT CASE	GENERAL BUILDING			BRACED BUILDING		
		M1 KN-M	M2 KN-M	M3 KN-M	M1 KN-M	M2 KN-M	M3 KN-M
SCUT1	DEAD	124318.3	15383.25	-4.61E-08	238358.2	6970.706	1.85E-08
SCUT1	LIVE	55841.33	7052.5	1.34E-08	79983.1	2171.55	7.50E-09
SCUT1	FF	-86690.6	1.86E-06	-1847.87	26661.03	723.85	2.52E-09
SCUT1	EQX	3.59E-06	-86690.6	15914.36	26661.03	723.85	-2.18E-07
SCUT1	EQY	0	0	0	26661.03	723.85	2.01E-07
SCUT1	WINDX	0	0	0	0	0	0
SCUT1	WINDY	0	0	0	0	0	0

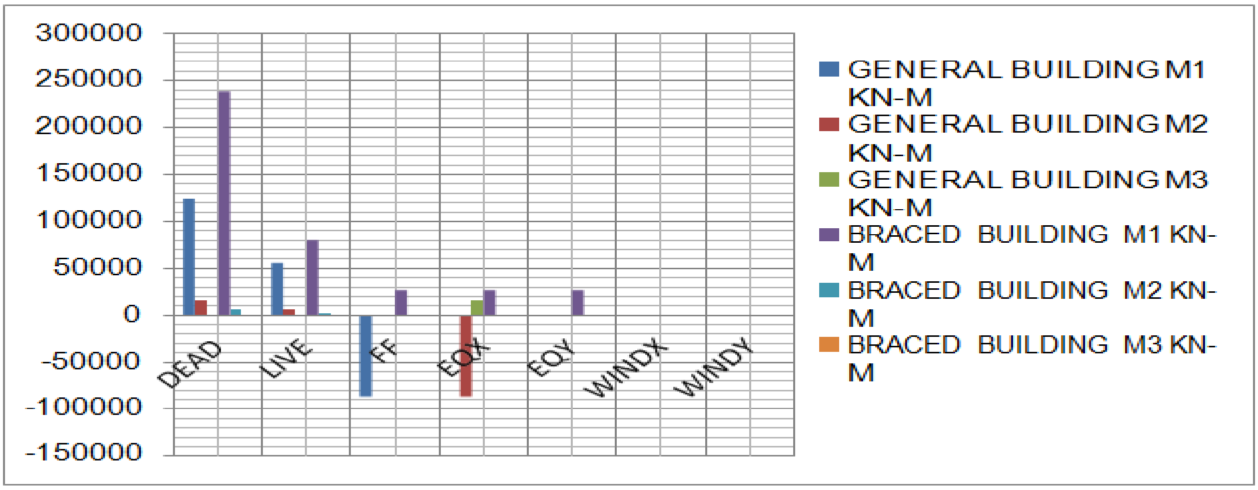


Fig No: 20The section cut (moments) obtained for both general building and braced building

From the fig no.20 it reflects that the values of dead load in braced building M1 shows greater values than the general building M1 .The live load in the braced building M1 shows greater values than the general building M1 but the values of live load in general building M2 shows greater values than the braced building M2. The floor finish for general building M1 has negative values where as for braced building M1 has positive values. The earthquake EQ X in braced building shows greater values than the general building.EQ Y for general buildings is zero where as for braced buildings EQ Y has positive values. The wind x and wind y are zero for both general and braced building. By providing braces in the frame, the horizontal load at node is distributed among brace members along with beams and columns. Due to arrangement of the bracing system in the building bending moment comparatively reduces.

VI. CONCLUSIONS

From the above study the following conclusions are made

1. A base reaction has higher values for General Buildings in X-Direction and Y-Direction where as for the Braced buildings, higher values are noted in Z-Direction.
2. In X and Y Direction Shear force values are less for the Unsymmetrical Braced building where as in case of Z Direction it has higher values for the Unsymmetrical Braced building.
3. Moments in X-Direction, Y-Direction, Z-Direction have higher values for the General Building. So the Braced Buildings have less value of the Bending moments than the General Buildings.
4. Joint reactions also have higher values for the general buildings than braced buildings. Hence, the Unsymmetrical Braced system is generally preferable.
5. In case of section cut forces, forces (F1, F2, F3) have higher values for the Unsymmetrical braced systems than General buildings.
6. Moments (M1, M2, M3) also have higher values for the Unsymmetrical braced systems than General buildings.
7. The seismic response of the building changes with addition of braces in structure.
8. Due to arrangement of the bracing system in the building bending moment has reduced comparatively.

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