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IJIEMR Transactions, online available on 25th May 2018. Link :
http://www.ijiemr.org/downloads.php?vol=Volume-7&issue=ISSUE-05

Title: Dynamic Study of Multi Storey Steel Structures.

Volume 07, Issue 05, Page No: 94 – 99.

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DYNAMIC STUDY OF MULTI STOREY STEEL STRUCTURES

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ABSTRACT - In every aspect of human civilization, we needed structures to live in or to get what we need. But it is not only building structures but to build efficient structures so that it can fulfill the main purpose for what it is made for. The action applied to a structure by an earthquake is a ground movement with horizontal and vertical components. The horizontal movement is the most specific feature of earthquake action because of its strength and because structures are generally better designed to resist gravity than horizontal forces. Experience shows that steel structures subjected to earthquakes behave well. Global failures and huge numbers of casualties are mostly associated with structures made from other materials.

Key Words: Staad pro,Static analysis& Dynamic analysis

1. INTRODUCTION

A building is exposed to a large number of different loads as shown in Fig.2. They can be static or dynamic, come from outside or inside of the building. Simple categorization of them may be based on its direction; vertically or horizontally. Vertical loads also known as gravity loads generally consist of dead loads, live loads, and snow loads. Horizontal, or lateral loads, may occur in the form of wind load, tilt and seismic responses. This may be explained by some of the specific features of steel structures. Steel structures are generally light in comparison to those constructed using other materials. As earthquake forces are associated with inertia, they are related to the mass of the structure and so reducing the mass inevitably leads to lower seismic design forces. Indeed some steel structures are sufficiently light that seismic design is not critical. This is particularly the case for halls/sheds: they create an envelope around a large volume so their weight per unit surface area is low and wind forces, not seismic forces, generally govern the design. This means that a building designed for gravity and wind loads implicitly provides sufficient resistance to earthquakes. This explains why in past earthquakes such buildings have been observed to perform so much better than those made of heavy materials.

TYPES OF STRUCTURAL STEEL:

The structural designer is now in a position to select structural steel for a particular application from the

following general categories.

a) Carbon steel (IS 2062):

Carbon and manganese are the main strengthening elements. The specified minimum ultimate tensile strength
for these varies about 380 to 450 MPa and their specified minimum yield strength from about 230 to 300MPa(IS 800:2007)

b) High –strength carbon steel:

This steel specified for structures such as transmission lines and microwaves towers. The specified ultimate tensile strength, is ranging from about 480-550 MPa, and a minimum yield strength of about 350-400 MPa.

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c) Medium-and-high strength micro alloyed steel (IS 85000):

This steel has low carbon content but achieves high strength due to the addition of alloys such as niobium, vanadium, titanium, or boron. The specified ultimate tensile strength, is ranging from about 440-590 MPa, and a minimum yield strength of about 300-450 Mpa

d) High –strength quenched and temperature steels (IS 2003):

This steel is heat treated to develop high strength. The specified ultimate tensile strength, is ranging from about 700-950 MPa, and a minimum yield strength of about 550-700 MPa.

Classification of multi-storey buildings:

The various structural systems can be broadly classified into two main types:

1. Medium-height buildings with shear-type deformation predominant.
2. Multi-storey cantilever structures such as framed tubes, diagonal tubes and braced trusses.

2. LITERATURE REVIEW

V.Varalakshmi: The design and analysis of multistoried G+5 building at Kukatpally, Hyderabad, India. The Study includes design and analysis of columns, beams, footings and slabs by using well known civil engineering software named as STAAD.PRO. Test on safe bearing capacity of soil was obtained.

P.Jayachandran: The design and analysis of multistoried G+4 building at Salem, tamilnadu, India. The study includes design and analysis of footings, columns, beams and slabs by using two software's named as STAAD.PRO and RCC Design Suit.

L.G.Kalurkar: The design and analysis of multistoried G+5 building using composite structure at earthquake zone-3. A three dimensional modeling and analysis of the structure are carried out with the help of SAP 2000 software. Equivalent Static Method of Analysis and Response spectrum analysis method are used for the analysis of both Composite and RCC structures. The results are compared and found that composite structure more economical.

3. PRESENT WORK

The three dimensional, 20- storey 4 bays along the width each bay of length 6m considered as main beams and 5 bays along the length each bay of length 5m considered as joists. The total width is 24m and length is 25m. The steel building shown in Figure 4.1 is used to investigate the seismic response of the structure in different earthquake zones by employing response spectrum method of analysis. For the analysis X-braced framed systems were selected in order to compare the response of various forces in the structure if it is present in different earthquake zones. The braces are provided diagonally in the end bays along the all stories.. The yield stress of the beams and columns considered as 240 and 330 MPa respectively

3.1 STRUCTURAL LAYOUT:

In building construction, greater economies can be achieved when the column grids in plan are rectangular in which the secondary beams should span in the longer direction and the primary beams in the shorter direction. This arrangement reduces number of beam-to-beam connections and the number of individual members per unit area of supported floor. In gravity frames, the beams are assumed to be simply supported between columns. The effective beam span to depth ratio(L/D) is about 12 to 15 for steel beams and 18 to 22 for simply supported composite beams. The design of beam is often dependent on the applied load, the type of beam system employed and the restrictions on structural floor depth. The floor-

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to-floor height in a multistorey building is influenced by the restrictions on overall building height and the requirements for services above and/or below the floor slab.

4. MODELLING AND ANALYSIS

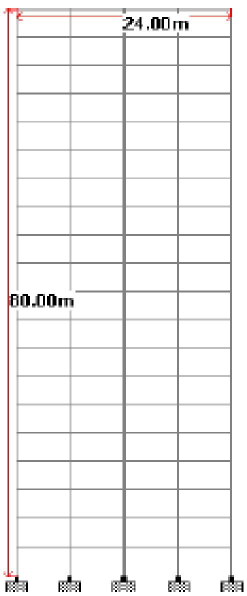

Fig: 1 20 storey Model Structure for analysis

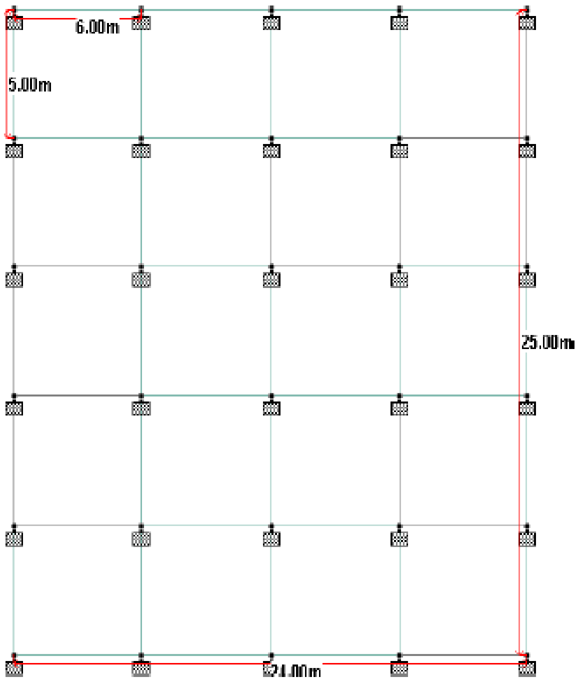

Fig: 2 Plan view of the building

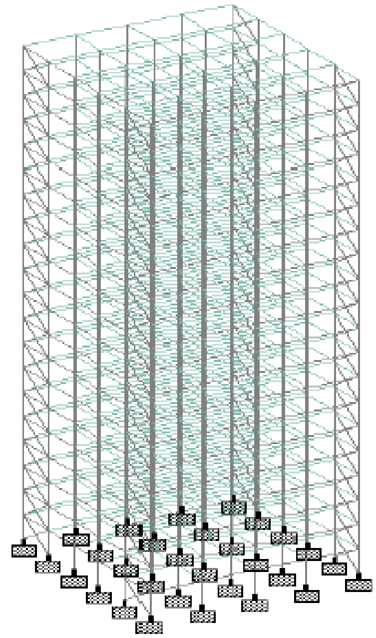

Fig:3 3D-View of the building

Building data

Type of the Building	Multi Storey Building (G + 20)	
Width	6 + 6 + 6 + 6 m C/C	
Length	5 + 5 + 5 + 5 + 5 m C/C	
Clear Height	80.0 m from FFL	
Roof Slope	FLAT ROOF	
Main Frame Column Spacing	6 + 6 + 6 + 6 m	
Bay Spacing	5 @ 5 M	
End Wall Column Spacing	4 @ 6	
Wall Bracing	cross bracing	

Loads considerations

Dead load : 5kN/m²

Floor finish :1.5kN/m²

Live load :5kN/m²

Partition load : 2kN/m²

Wind s : 44m/sec

Seismic : Zone-3; RF-5; I-1; SS-2; ST-2; DM-0.02

Sl. No	Materials	Specifications	Grade/yield strength
1.	Built-Up Members	ASTM A572 Grade 50	F_x = 34.5 kN/cm^2
2.	Hot-Rolled Members		
	• Beams	I.S.-2062	F_x = 24.5 kN/cm^2
	• Tubes and Angles	I.S.- 2062	F_x = 24.5 kN/cm^2
	• Galvanized	ASTM A 653 M	F_x = 34.5 kN/cm^2
4.	X-Bracing Members		
	• Angle & Rod	I.S. 2062	F_x = 24.5 kN/cm^2
5.	Anchor Bolts		
6.	High Strength Bolts	ASTM A325 Electro-Galvanized	Grade 8.8/62 KN/cm^2
7.	Machine Bolts	ASTM A 307 Electro -galvanized	Grade 4.6/31 KN/cm^2

5. RESULT AND ANALYSIS RESPONSE SPECTRUM LOADING (DYNAMIC LOADING):

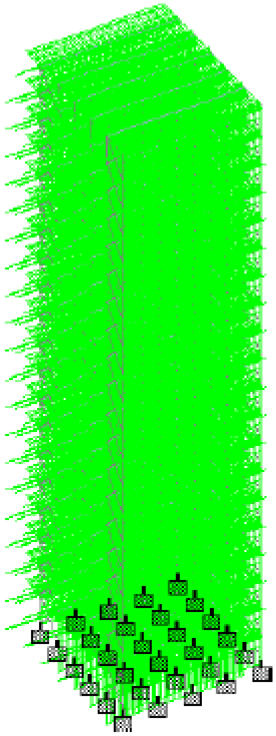

Fig:4 Response spectrum loading in 3D frame

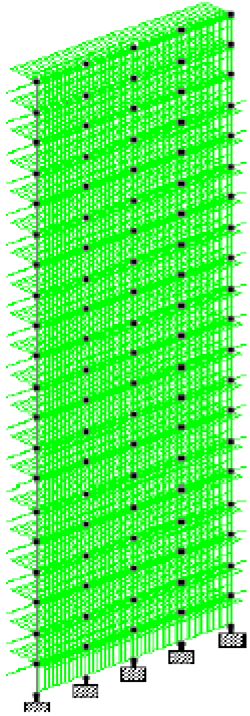

Fig: 5 Response spectrum loading along single grid

STATIC LOADING

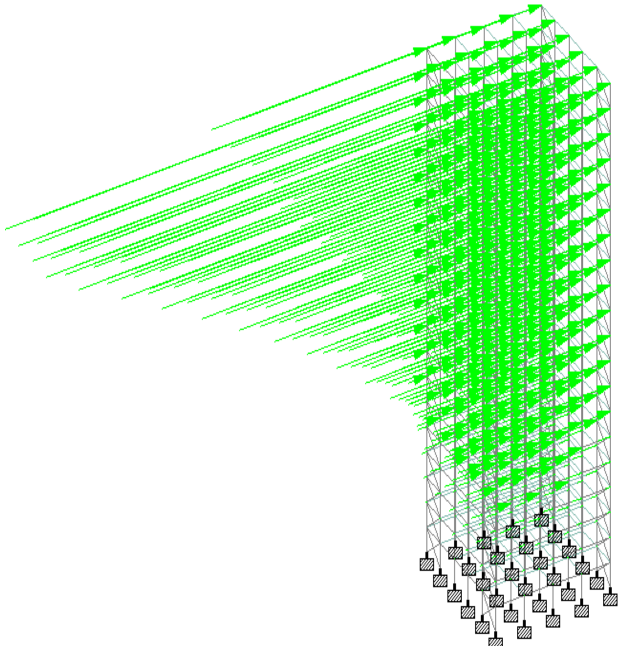

Fig:6 Static loading in 3D structure

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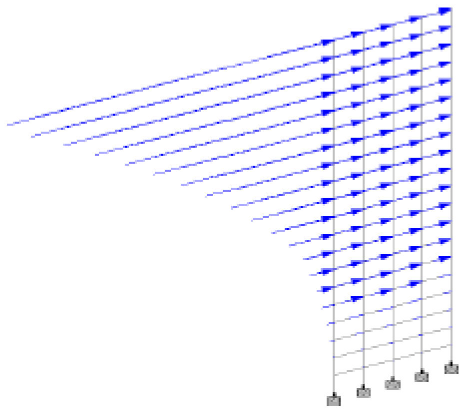

Fig: 7 Static loading in a single frame

Table no:3 Base shear at different levels in various zones along X-Direction

STOREY	LEVEL IN METERS	PEAK STOREY SHEAR IN KN (X-Direction)			
		ZONE-2	ZONE-3	ZONE-4	ZONE-5
20	80	211.2	338.0	506.9	760.3
19	76	410.6	657.1	985.5	1478.2
18	72	540.5	864.8	1297.1	1945.6
17	68	627.7	1004.4	1506.5	2259.6
16	64	698.3	1117.3	1675.7	2513.5
15	60	753.8	1206.2	1809.1	2713.5
14	56	797.7	1276.4	1914.4	2871.4
13	52	833.3	1333.4	1999.8	2999.6
12	48	865.2	1384.4	2076.4	3114.4
11	44	897.7	1436.4	2154.4	3231.4
10	40	933.7	1494.0	2240.8	3361
9	36	975.0	1560.1	2339.9	3509.8
8	32	1021.2	1634.0	2450.7	3675.8
7	28	1069.4	1711.1	2566.4	3849.5
6	24	1116.7	1786.8	2679.9	4019.7
5	20	1160.3	1856.6	2784.6	4176.7
4	16	1198.1	1917.1	2875.3	4312.7
3	12	1229.8	1967.8	2951.4	4426.8
2	8	1257.5	2012.0	3017.8	4526.4
1	4	1285.4	2056.7	3084.7	4626.8
BASE	0	1285.4	2056.7	3084.7	4626.8

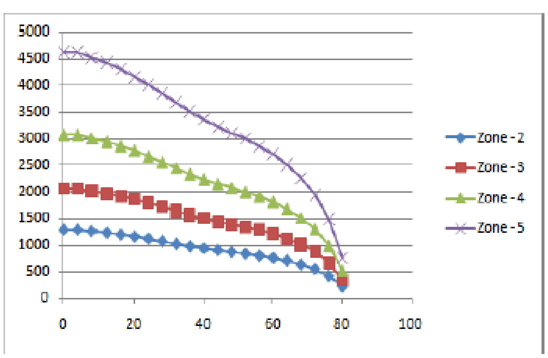

Fig:8 Base shear at different levels in various zones along X-Direction

Table no:4 Base shear at different levels in various zones along Z-Direction

STOREY	LEVEL IN METERS	PEAK STOREY SHEAR IN KN (Z-Direction)			
		ZONE-2	ZONE-3	ZONE-4	ZONE-5
20	80	236	377.0	565.2	848.3
19	76	441	705.2	1057.2	1586.9
18	72	560	896.5	1344.0	2017.5
17	68	630	1008.4	1511.8	2269.4
16	64	677	1083.2	1623.9	2437.6
15	60	705	1128.2	1691.4	2538.9
14	56	721	1153.7	1729.6	2596.3
13	52	732	1171.7	1756.5	2636.7
12	48	747	1194.7	1791.1	2688.6
11	44	771	1233.0	1848.5	2774.7
10	40	807	1290.8	1935.1	2904.8
9	36	854	1367.2	2049.7	3076.7
8	32	910	1456.5	2183.6	3277.8
7	28	969	1549.7	2323.3	3487.5
6	24	1025	1639.3	2457.6	3689.1
5	20	1075	1720.1	2578.8	3871.1
4	16	1119	1790.5	2684.2	4029.3
3	12	1158	1853.2	2778.2	4170.4
2	8	1197	1915.8	2872.2	4311.4
1	4	1241	1985.4	2976.4	4467.9
BASE	0	1241	1985.4	2976.4	4467.9

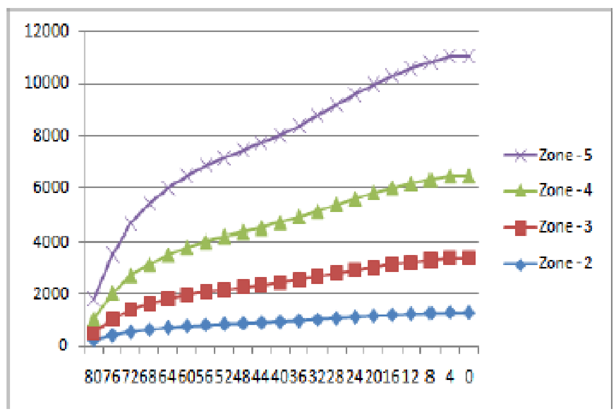

Fig: 9 Base shears at different levels in various zones along Z-Direction

6. CONCLUSIONS

The results as obtained for all Zones II, III, IV,V using STAAD PRO 2006 for Static &Dynamic Analysis are compared for different categories under different nodes and beams. As per the results in Table No 6.4Zone II, III, IV, V, we can see that there is much difference in the values of Axial Forces as obtained by Static &Dynamic Analysis of the Steel Structure. As per the results in Table No 6.5, Zone II,III, IV, V, we can see that the values of Moments are higher for Static analysis than the values

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obtained by Dynamic Analysis of the for the moments at same points. As per the results in Table No 6.6, Zone II,III, IV, V, we can see that the values of Torsion at different points in the beam are Negative in Static analysis and for Dynamic Analysis the values for Torsion are positive. As per the results in Table No 6.7, Zone II,III, IV, V, we can see that the values of Displacements at different points in the beam are higher for Static analysis and for Dynamic Analysis the values are lesser. The values of seismic responses namely base shear, storey displacement and storey drifts for all the Time Histories are found to be of the increased order for seismic intensities varying from Floor to floor. The performance of Steel Framed Structure is analysed for zone II, III, IV, V for Dynamic Analysis and the results are tabulated. It can be concluded that the results as obtained for the Dynamic Analysis are increasing for every zone higher for the same points and conditions.

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