IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

ANALYSIS OF SHEAR WALL FRAMED BUILDING FOR DIFFERENT LOCATION UNDER SEISMIC CONDITION

[1] Mohan Kanojiya, [2]Vaibhav Assudani, [3]Anchal Rahate, [4]Nazeef Afzal, [5]Prof. Sayyed Aamir Hussain
[1]UG Student, [2]UG Student, [3]UG Student, [4]UG Student, [5]Professor
[1]Department of Civil Engineering,
[1] Anjuman College of Engineering & Technology, Nagpur, India

Abstract: In seismic design of multistoried building, shear walls are most common structure adopted to make the structure earthquake resistant. These are constructed to counteract the lateral loads caused by wind load and seismic loads. Shear walls provide adequate stiffness to the structure. So that the lateral drift will be in limits. Generally shear walls are the vertical cantilever which acts as a column. This investigation presents the study and comparison of earthquake behaviour of buildings with and without shear wall using STAAD Pro. In this study, reinforced concrete buildings are analyzed by changing the various position of shear wall with different locations considering various parameters such as story drift, lateral displacement and others.

***Index Terms* - Seismic analysis, Shear wall, Story drift, STAAD Pro V8i.**

I. INTRODUCTION

Now-a-days multistoried buildings are rapidly constructed everywhere in the world and they are more slender and more sway than earlier buildings. The deformation of tall structures is composed of axial, bending, torsion, transverse shear. In recent period many new concepts and methods are adopted in field of seismic design. In general, RCC structures are constructed to control the lateral displacement. Shear walls are most common structural system which provides lateral stiffness and stability against the lateral loads. In frame structure, the shear walls behaviour is similar to the column which is subjected to combined flexure and axial load. So these are also called flexural members. Shear walls require proper designing and detailing in high seismic regions. Therefore it is necessary to determine the efficient, effective and ideal location of shear wall. This paper represents the analysis of structure with the effect of shear wall position on lateral displacement and story drift in RC frames. The analysis of shear wall was performed by STAAD Pro V8i using surface elements.

II. LITERATURE REVIEW

Shear wall system is most significantly used for tall structure in earthquake prone area. So, there are many research work was done in various aspects of shear walls which are as follows:

P.P. Chandurkar et.al. (2013) presented a study on "seismic analysis of RCC building with and without shear wall". The paper determined the lateral displacement, story drift ratio, concrete quantity, total cost, % of Ast in column required of tenth storied building calculated by placing the shear wall in different location. From that analysis, the building with shear in short span at corner (model 4) is economical as compared to others.

Wakchaure M.R et.al.(2012) presented a study on "earthquake analysis of high rise building with and without infill walls". In this analysis G+9, RCC frame building with the effect of masonry infill wall was studied. The top story displacement of high rise building reduces due to infill walls.

K.LovaRaju et.al.(2015) studied the effective location of shear wall on performance of building frame subjected to earthquake load. The pushover analysis for various models observed the structure with appropriate placed of shear wall has more significant of displacement and base shear

III. BUILDING MODELLING

In the present study, a RCC G+10 storied residential building with 3 meters height for each story is modeled. This residential building is designed as a plan of 24 x 30 m with a lift at centre. M25 grade of concrete and Fe 500 structural steel is used. The structure is supported as fixed at its base. The buildings are modeled and analyzed by using the software STAAD Pro V8i. Models are studied four zone IV comparing story drift, maximum lateral displacement etc. The study of models is designed by placing the shear wall in different location with the thickness of 250mm.

Model 1- BARE FRAME

Model 2- POSITION ‘A’

Model 3- POSITION ‘B’

Model 4- POSITION ‘C’

Model 5- POSITION ‘D’

3.1 Physical Details

The preliminary data taken for the analysis is as follows:- All the dimensions in mm. • No of stories: G+10

• Storey height: 3 m

• Beam size in all direction: 300 x 500 $mm2$

• Column size: 400 x 500 $mm2$

• Thickness of the slab:150mm

• Grade of concrete: M25

• Grade of steel: Fe500

• Density of concrete: 25 KN/$m3$

• Density of brick: 20 KN/$m3$

3.2 Building Plans

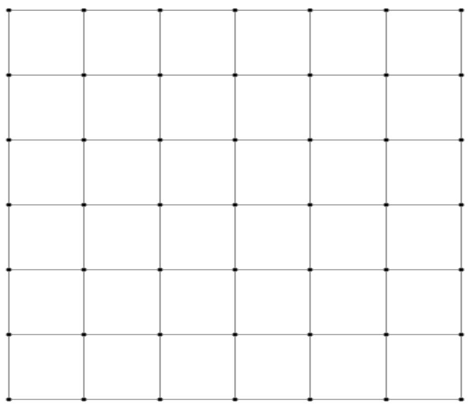

Fig 1:- Plan of Bare Frame Building

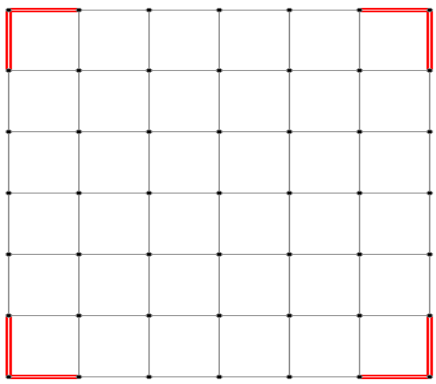

Fig 2:- Plan of Shear Wall At Position ‘A’

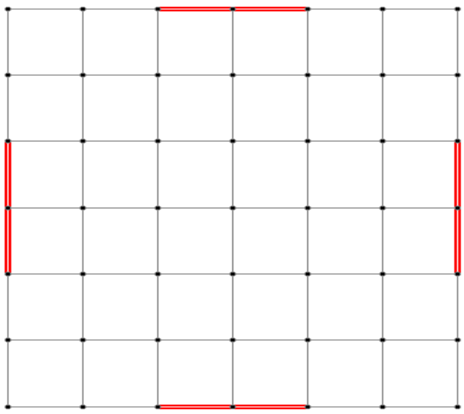

Fig 3:- Plan of Shear Wall At Position ‘B’

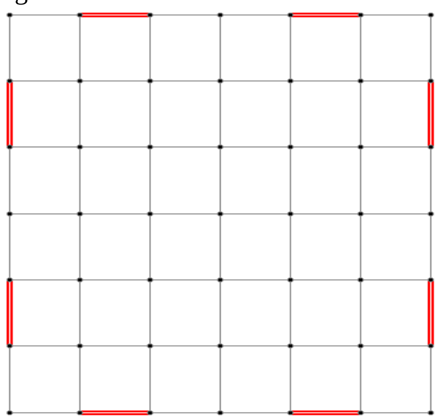

Fig 4:- Plan of Shear Wall At Position ‘C’

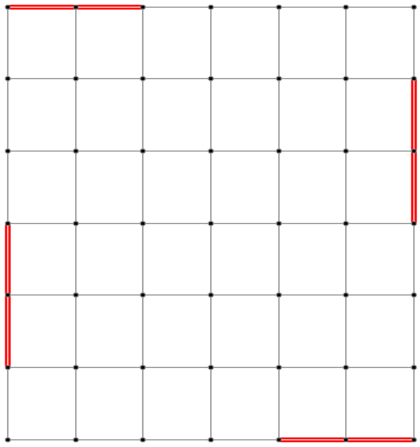

Fig 5:- Plan of Shear Wall At Position 'D'

Methodology

The loading of building is subjected to dead load and live load as per IS 875 (Part 1) (Part 2): 1987 respectively. As per Indian Code of Practice IS 1893 (Part 1): 2016, design the multistoried residential building against earthquake and wind loads. The member forces are calculated with load combination given in IS 456: 2000. Seismic provision for this building:

- Seismic zone : IV
- Types of the frame : Special Moment Resisting Frame
- Response reduction factor (R) : 5.0
- Importance factor (I) : 1.2
- Soil type : Medium soil
- Damping ratio : 5%

LOAD CASES & COMIBATIONS

LOAD CASE		DESCRIPTION
1	EQX+	Seismic in X +ve direction
2	EQX-	Seismic in X -ve direction
3	EQZ+	Seismic in Z +ve direction
4	EQZ-	Seismic in Z -ve direction
5	D.L	Dead Load
6	L.L	Imposed Load
7	RSX	Response spectrum in X direction
8	RSZ	Response spectrum in Z direction

NO.	LOAD COMBINATIONS
9	D.L+L.L
10	1.5(D.L+L.L)
11	1.2 (D.L+L.L+EQ X+
12	1.2 (D.L+L.L+EQX-)
13	1.2 (D.L+L.L+EQZ+)
14	1.2 (D.L+L.L+EQZ-)
15	1.5 (D.L+EQX+)
16	1.5 (D.L+EQX-)
17	1.5 (D.L+EQZ+)
18	1.5 (D.L+EQZ-)
19	0.9 D.L + 1.5 EQ X+
20	0.9 D.L + 1.5 EQ X-
21	0.9 D.L + 1.5 EQ Z+
22	0.9 D.L + 1.5 EQ Z-
23	D.L+0.8LL+0.8EQX
24	D.L+0.8LL-0.8EQX
25	D.L+0.8LL+0.8EQZ
26	D.L+0.8LL-0.8EQZ
27	D.L+EQX
28	D.L-EQX
29	D.L+EQZ
30	D.L-EQZ
31	D.L+0.25LL

IV. ANALYSIS AND RESULT

The structural analysis of all models with and without shear walls have been done by using STAAD Pro. The comparison of different parameters such as maximum lateral displacement, story drift and other parameters are studied.

1. BASE SHEAR CRITERA

Frame Type	Load Case	Storey	Levels	Max. Storey Shear in X direction	Max. Storey Shear in Z direction
Bare Frame	RSX	Base	-3.00	3589.04	3589.32
A	RSX	Base	-3.00	3752.05	3771.39
B	RSX	Base	-3.00	3954.24	4261.90
C	RSX	Base	-3.00	4294.04	4268.96
D	RSX	Base	-3.00	4849.38	5064.36
POSITION 'B' 'C'& 'D' ARE EFFECTIVE IN DEFLECTION CRITERIA					

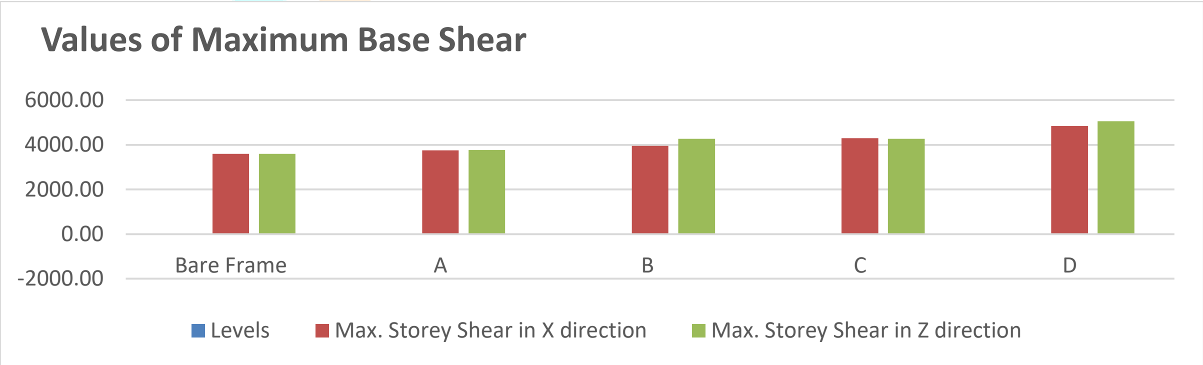

Fig 6:- Graph for Maximum Base Shear

2. DEFLECTION CRITERA

DISPLACEMENT VALUES BY STAAD PRO									
S.No.	Frame type	Total building height	Node No.	Load Combination	Max. Displacement in 'X' Direction	Max. Displacement in 'Z' Direction	Max. permissible displacement allowed - H/500	Check for X direction	Check for Z direction
---	---	(m)	---	(L/C)	(mm)	(mm)	(mm)	---	---
1	Bare Frame	33	625	DL+EQ	66.38	62.39	66	NOT OK	OK
2	A	33	625	DL+EQ	34.24	27.73	66	OK	OK
3	B	33	625	DL+EQ	27.27	29.15	66	OK	OK
4	C	33	625	DL+EQ	37.11	31.04	66	OK	OK
5	D	33	627	DL+EQ	30.55	21.49	66	OK	OK
POSITION 'B' & 'D' ARE EFFECTIVE IN DEFLECTION CRITERIA									

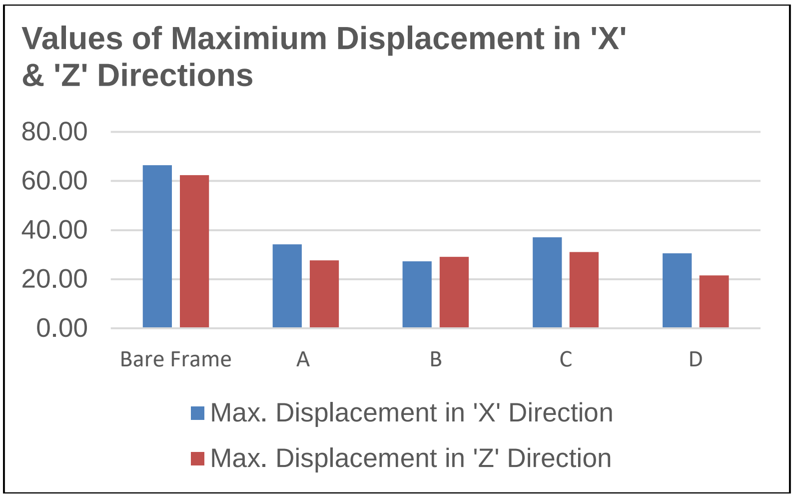

Fig 7:- Graph for Maximum Displacement

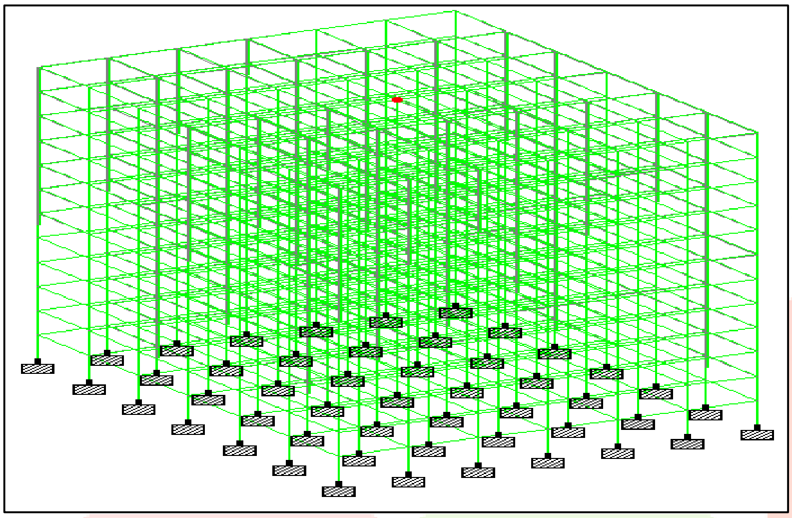

Fig 8: Deflection In Building

3. STOREY DRIFT CRITERA

STOREY DRIFT CALCULATIONS

S.No.	Frame Type	Node No.	Load Combination	Max. Displacement in 'X' Direction (dx)	Max. Displacement in 'Z' Direction (dz)	Floor to Floor Height	Storey drift (Dx)	Storey drift (Dz)	Storey drift limitation (0.004H)	Check for X direction	Check for Z direction
---	---	(m)	(L/C)	(mm)	(mm)	(m)	(mm)	(mm)	(mm)	---	---
		20	DL+EQ	4.89	4.08	3.00	4.89	4.08	12	OK	OK
		120	DL+EQ	11.89	10.62	3.00	7.00	6.54	12	OK	OK
		169	DL+EQ	19.11	17.55	3.00	7.22	6.93	12	OK	OK
		218	DL+EQ	26.31	24.47	3.00	7.20	6.92	12	OK	OK
		267	DL+EQ	33.37	31.24	3.00	7.06	6.77	12	OK	OK
1	Bare Frame	316	DL+EQ	40.18	37.74	3.00	6.81	6.50	12	OK	OK
		365	DL+EQ	46.59	43.85	3.00	6.41	6.11	12	OK	OK
		414	DL+EQ	52.44	49.39	3.00	5.85	5.54	12	OK	OK
		463	DL+EQ	57.55	54.20	3.00	5.11	4.81	12	OK	OK
		512	DL+EQ	61.70	58.08	3.00	4.15	3.88	12	OK	OK
		561	DL+EQ	64.68	60.83	3.00	2.98	2.75	12	OK	OK
		610	DL+EQ	66.38	62.39	3.00	1.70	1.56	12	OK	OK
		37	DL+EQ	0.91	0.70	3.00	0.91	0.70	12	OK	OK
		135	DL+EQ	2.67	2.04	3.00	1.76	1.34	12	OK	OK
		184	DL+EQ	5.04	3.86	3.00	2.37	1.82	12	OK	OK
		233	DL+EQ	7.87	6.06	3.00	2.83	2.20	12	OK	OK
		282	DL+EQ	11.00	8.52	3.00	3.13	2.46	12	OK	OK
2	A	331	DL+EQ	14.31	11.16	3.00	3.31	2.64	12	OK	OK
		380	DL+EQ	17.71	13.90	3.00	3.40	2.74	12	OK	OK
		429	DL+EQ	21.09	16.66	3.00	3.38	2.76	12	OK	OK
		478	DL+EQ	24.38	19.39	3.00	3.29	2.73	12	OK	OK
		527	DL+EQ	27.53	22.04	3.00	3.15	2.65	12	OK	OK
		576	DL+EQ	30.50	24.57	3.00	2.97	2.53	12	OK	OK
		625	DL+EQ	33.28	26.96	3.00	2.78	2.39	12	OK	OK

STOREY DRIFT CALCULATIONS

S.No.	Frame Type	Node No.	Load Combination	Max. Displacement in 'X' Direction (dx)	Max. Displacement in 'Z' Direction (dz)	Floor to Floor Height	Storey drift (Dx)	Storey drift (Dz)	Storey drift limitation (0.004H)	Check for X direction	Check for Z direction
---	---	(m)	(L/C)	(mm)	(mm)	(m)	(mm)	(mm)	(mm)	---	---
3	B	37	DL+EQ	0.77	0.58	3.00	0.77	0.58	12	OK	OK
		135	DL+EQ	2.15	1.60	3.00	1.38	1.02	12	OK	OK
		184	DL+EQ	3.99	2.95	3.00	1.84	1.35	12	OK	OK
		233	DL+EQ	6.19	4.57	3.00	2.20	1.62	12	OK	OK
		282	DL+EQ	8.64	6.38	3.00	2.45	1.81	12	OK	OK
		331	DL+EQ	11.24	8.33	3.00	2.60	1.95	12	OK	OK
		380	DL+EQ	13.93	10.36	3.00	2.69	2.03	12	OK	OK
		429	DL+EQ	16.62	12.42	3.00	2.69	2.06	12	OK	OK
		478	DL+EQ	19.27	14.45	3.00	2.65	2.03	12	OK	OK
		527	DL+EQ	21.82	16.44	3.00	2.55	1.99	12	OK	OK
		576	DL+EQ	24.24	18.34	3.00	2.42	1.90	12	OK	OK
		625	DL+EQ	26.50	20.14	3.00	2.26	1.80	12	OK	OK
4	C	37	DL+EQ	1.02	0.78	3.00	1.02	0.78	12	OK	OK
		135	DL+EQ	3.06	2.36	3.00	2.04	1.58	12	OK	OK
		184	DL+EQ	5.83	4.52	3.00	2.77	2.16	12	OK	OK
		233	DL+EQ	9.10	7.11	3.00	3.27	2.59	12	OK	OK
		282	DL+EQ	12.67	9.98	3.00	3.57	2.87	12	OK	OK
		331	DL+EQ	16.38	13.02	3.00	3.71	3.04	12	OK	OK
		380	DL+EQ	20.11	16.12	3.00	3.73	3.10	12	OK	OK
		429	DL+EQ	23.73	19.19	3.00	3.62	3.07	12	OK	OK
		478	DL+EQ	27.18	22.17	3.00	3.45	2.98	12	OK	OK
		527	DL+EQ	30.39	25.01	3.00	3.21	2.84	12	OK	OK
		576	DL+EQ	33.34	27.68	3.00	2.95	2.67	12	OK	OK
		625	DL+EQ	36.04	30.16	3.00	2.70	2.48	12	OK	OK

STOREY DRIFT CALCULATIONS

S.No.	Frame Type	Node No.	Load Combination	Max. Displacement in 'X' Direction (dx)	Max. Displacement in 'Z' Direction (dz)	Floor to Floor Height	Storey drift (Dx)	Storey drift (Dz)	Storey drift limitation (0.004H)	Check for X direction	Check for Z direction
---	---	(m)	(L/C)	(mm)	(mm)	(m)	(mm)	(mm)	(mm)	---	---
1	Bare Frame	20	DL+EQ	4.89	4.08	3.00	4.89	4.08	12	OK	OK
5	D	39	DL+EQ	0.80	0.58	3.00	0.80	0.58	12	OK	OK
		137	DL+EQ	2.27	1.60	3.00	1.47	1.02	12	OK	OK
		186	DL+EQ	4.25	2.96	3.00	1.98	1.36	12	OK	OK
		235	DL+EQ	6.63	4.58	3.00	2.38	1.62	12	OK	OK
		284	DL+EQ	9.31	6.40	3.00	2.68	1.82	12	OK	OK
		333	DL+EQ	12.18	8.36	3.00	2.87	1.96	12	OK	OK
		382	DL+EQ	15.16	10.40	3.00	2.98	2.04	12	OK	OK
		431	DL+EQ	18.17	12.46	3.00	3.01	2.06	12	OK	OK
		480	DL+EQ	21.15	14.51	3.00	2.98	2.05	12	OK	OK
		529	DL+EQ	24.04	16.51	3.00	2.89	2.00	12	OK	OK
		578	DL+EQ	26.82	18.42	3.00	2.78	1.91	12	OK	OK
		627	DL+EQ	29.43	20.22	3.00	2.61	1.80	12	OK	OK

POSITION 'B' & 'D' ARE EFFECTIVE IN DEFLECTION CRITERIA

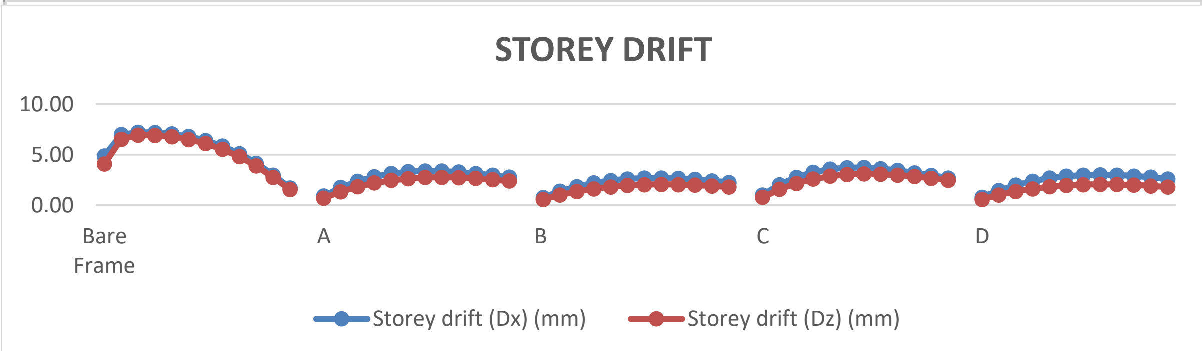

Fig 9: Graph for Maximum Storey Drift

4. FUNDAMENTAL NATURAL PERIOD CRITERA

MODE	Maximum Fundamental Natural Period (T) in sec.				
	Bare Frame	A	B	C	D
1	2.245	1.452	1.292	1.533	1.341
2	2.175	1.296	1.120	1.384	1.123
3	2.038	0.904	0.842	1.076	0.872
4	0.738	0.383	0.339	0.419	0.344
5	0.711	0.329	0.289	0.362	0.290
6	0.670	0.219	0.212	0.274	0.215
7	0.428	0.200	0.197	0.198	0.198
8	0.409	0.188	0.186	0.196	0.188
9	0.391	0.186	0.180	0.186	0.181
10	0.298	0.179	0.173	0.181	0.174
11	0.280	0.174	0.172	0.171	0.173
12	0.271	0.172	0.163	0.170	0.163
13	0.225	0.168	0.160	0.167	0.161
14	0.207	0.161	0.160	0.160	0.161
15	0.203	0.160	0.160	0.158	0.159
POSITION ‘B’ & ‘D’ ARE EFFECTIVE IN DEFLECTION CRITERIA					

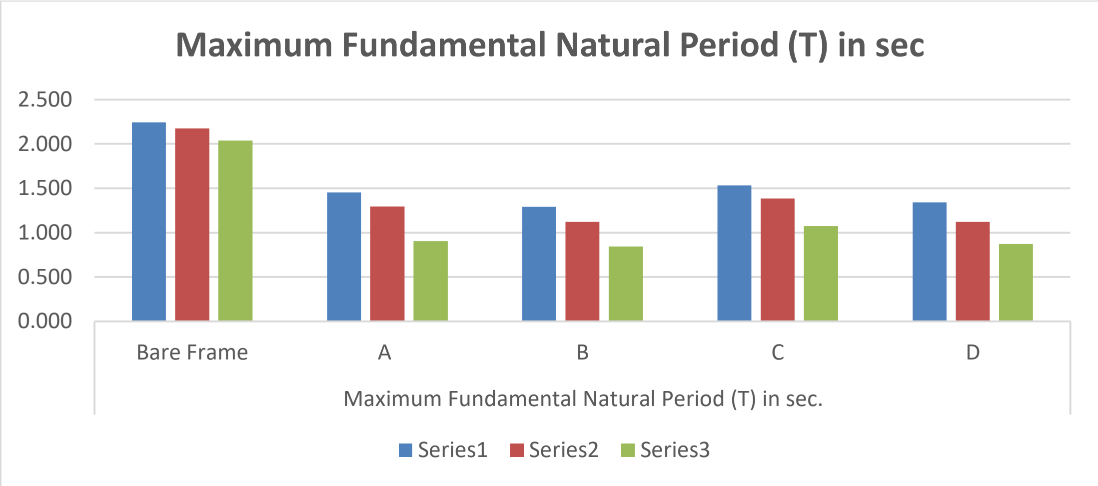

Fig 10: Graph for Maximum Natural Period

V. CONCLUSION

- From the comparison of the result it is found that the effective location of shear wall is found in the corner of the building.
- It can be concluded the provision of the shear wall decrease the time period comparatively with the bare frame.
- To provide shear wall increase the seismic performance of the structure.
- Tested model are A,B,C,D &Bare frame (without shear wall). In this tested models we observed that two of them B & D are effectively resist the criteria story drift than bare frame.

REFERENCES

[1] AnshulSud, Raghav Singh Shekhawat, PoonamDhimanBest Placement Of Shear Walls In An RCC Space Frame Based On Seismic Response National Conference on Advances in Engineering and Technology (AET- 29th March 2014)
[2] H.S.Jadhavand AnujaWalvekarParametric Study Of Flat Slab Building With And Without Shear Wall To Seismic Performance. International Journal of Research in Engineering and Technology (IJRET), ISSN: 2319-1163, Volume: 04 Issue: 04 | Apr-2015
[3] S K Hirde and N K ShelarEffect Of Positioning Of RC Shear Walls On Seismic Performance Of Buildings Resting On Plain And Sloping Ground International Journal of Current Engineering and Technology (IJCET) Vol.5, No.3 (June 2015)
[4] M R Suresh , AnanthShayanaYadavThe Optimum Location Of Shear Wall In High Rise R.C Bulidings Under Lateral Loading International Journal of Research in Engineering and Technolog (IJRET)y eISSN: 2319-1163 Volume: 04 Issue: 06 | June-2015
[5] Mr.K.LovaRaju, Dr.K.V.G.D.BalajiEffective Location Of Shear Wall On Performance Of Building Frame Subjected To Earthquake Load International Advanced Research Journal in Science, Engineering and Technology (IARJSET)Vol. 2, Issue 1, January 2015
[6] Rajesh JayarambhaiPrajapati&Vinubhai. R. Patel Effect Of Different Position Of Shear Wall On Deflection In High Rise Building International Journal of Advances in Engineering & Technology, (IJAET) Sept. 2013 ISSN: 22311963
[7] S K. Hirde and Ms. S. T. Charjan, (2009), Effect of various positions of reinforced concrete shear walls on seismic performance of building having soft bottom storey, ISSE Journal, Volume 11-1.
[8] SejalBhagat,”Effect of change shear wall location on storey drift of multi-storey building subjected to lateral loads”, International Journal of Research Engineering and Technology, ISSN: 2319-1163, Vol.3, January2014, pp 56-74.
[9] AnshulSud, Raghav Singh Shekhawat, PoonamDhiman,”Best Placement of shear walls in an RCC Space Frame Based on Seismic Response”, International Journal of Engineering Research and Applications, ISSN: 2248-9622,March2014,pp35-38.
[10] Prof. JayasreeRamanujan, Mrs. Bindu Sunil, Dr. LajuKottallil, Prof. Mercy Joseph PowethEffect Of Shear Wall Location In Buildings Subjected To Seismic Loads ISOI Journal of Engineering and Computer science.

[11] IS 1893 (Part I), Criteria for earthquake resistant design of structures, Part I: General provisions for buildings, fifth revision, Bureau of I.S., New Delhi, India, 2002

[12] IS: 875 (Part 1) – 1987, "Indian Standard Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures", Bureau of Indian Standards, 1989.

[13] IS: 875 (Part 2) – 1987, "Indian Standard Code of Practice for Design Loads (other than Earthquake) for buildings and structures", Bureau of Indian Standards, 1989.

[14]. IS 13920:1993,Ductile detailing of reinforced concrete structure subjected to seismic forces-code of practice.

[15]. SP: 16-design aids for reinforced concrete.

[16] Dynamics of structure by A K Chopra.