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FLAT SLAB SHEAR WALL INTERACTION FOR MULTISTORIED BUILDING ANALYSIS WHEN STRUCTURE LENGTH IS GREATER THAN WIDTH UNDER SEISMIC FORCES

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Keywords: *Tall Building, Shear Wall, Flat Slab*

ABSTRACT
In recent times there has been a considerable increase in the number of tall buildings, both residential and commercial, and modern trend is towards taller structures. Flat slab is most widely used systems in reinforced concrete construction. Flat-slab building structures possesses main advantages over traditional slab-beam-column structures taking a advantages of reduced floor height, shorter construction time, architectural – functional and economical aspects. But in flat slab building columns are directly provides supports to slab with eliminating beams so there is requirement of provision of shear walls to increase the stiffness of building against lateral forces. Shear wall system are one of the most commonly used lateral load resisting in high rise building. Shear wall has high in plane stiffness and strength. The aim of the present study is to evaluate the behavior of multi-storeyed building of conventional R.C.C. having flat slab with or without shear walls and to analyze the effect of building height and length on the performance under earthquake forces. Also effect of with or without shear wall for flat slab building on seismic behavior with varying thickness and varying position of shear wall are studied. In this work, the effects of seismic forces in zone V on these buildings are also carried out.
The aim is also shows that the behavior of various frames when the structure length is greater than its width. For this, G+9, G+18, G+27 and G+36 Storeyed models, each of plan size 20X50m are selected. For stabilization of the variable parameters, shear wall are provided at different locations. To study the effect of different location of shear wall on flat slab multi-storey building, static analysis (Equivalent Static Analysis) in software STAAD Pro is carried out for zone V. The seismic parametric studies comprise of lateral displacement, storey drift, drift reduction factor and contribution factor

INTRODUCTION
One of the major problems in the modern construction world is the problem of vacant land. This scarcity in urban areas has led to the vertical construction growth of low-rise, medium-rise, tall buildings and even sky-scraper (over 50 meters tall). These buildings generally used Framed Structures subjected to the vertical as well as lateral loads. In these structures, the lateral loads from strong winds and earthquakes are the main concerns to keep in mind while designing rather than the vertical loads caused by the structure itself. These both factors may be inversely proportional to each other as the building which is designed for sustaining vertical loads may not have the capacity to sustain or resist the above mentioned lateral loads. The lateral loads are the foremost ones as they are in contrast against one another as the vertical loads are supposed to increase linearly with height; on the other hand lateral loads are fairly variable and increase rapidly with height. For buildings taller than 15 to 20 stories, pure rigid frame system is not adequate because it does not provide the required lateral stiffness and causes excessive deflection of the building. These requirements are satisfied by two ways. Firstly, by increasing the members size above the requirements of strength but this approach has its limitation and secondly, by changing the structural form into more stable and rigid to restrict deformation. This increases the structure's stability and rigidity and also restricts the deformation requirement.

Flat Slab
In general practice of design and construction, the slabs are supported by beams and beams are supported by columns. This type of construction may be called as beam-slab construction. The available net ceiling height is reduced because of the beams. Therefore offices, warehouses, public halls and tall buildings are sometimes designed without beams and slabs are directly rest on columns. This type of beamless-slab construction called as flat slab, in which slab supported directly by columns without beams. For engineers, flat slabs construction give reduced floor height and for architectures, it give aesthetically and beautiful appearance

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Types of flat slab

Flat slabs have the following types:

- Flat slab without drop panel and column without column head.
- Flat slab with drop panel and column without column head.
- Flat slab without drop panel and column with column head.
- Flat slab with drop panel and column with column head

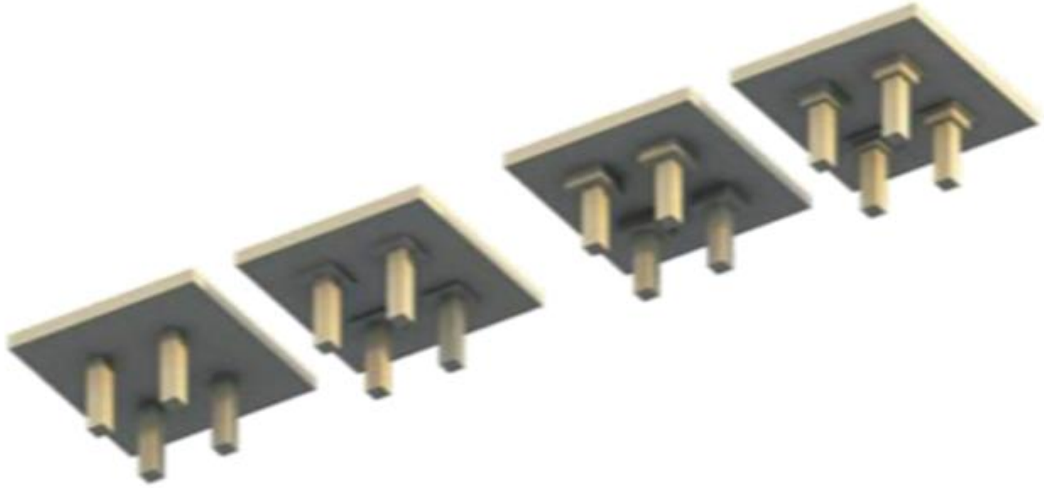

Figure Types of Flat Slab

Objective of the Study

The objectives of the present study are-

- Comparative Analysis of Natural Time Period(x direction)(sec.) with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Natural Time Period(z direction) (sec.) with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Average Response Acceleration Coefficient (Sa/g) (x direction) with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Average Response Acceleration Coefficient (Sa/g)(z direction)with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Base Shear(Vb)(KN) (x direction) with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Base Shear (Vb) (KN) (z direction) with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Sway (mm.) with length increased by 50 mfor 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Shear Force (KN) with length increased by 50 mfor 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Moment (KN-m)with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.
- Comparative Analysis of Axial Force (KN)with length increased by 50 m for 9 storeyed, 18 storeyed, 27 storeyed, 36 storeyed from frame 1 to frame 12.

METHODOLOGY AND MODELING APPROACH

General

The approximation of seismic demands at functioning levels which requires an explicit consideration of the inelastic behavior of structure. Currently it is widespread to estimate seismic demands in a simpler manner by dynamic analysis. The literature survey on seismic performance of shear wall reveals that dynamic analysis is widely adopted in seismic analysis of low as well as medium rise structures. Further, no such specific study of shear wall structures of their seismic performance has been available. However by extrapolating of present

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methodologies for framed structure is being adopted. This methodology is divided in to description of structures, load consideration, selection of parameters for study, model development and step by step method of static analysis in STAAD PRO for current work.

Methodology

The objective of present work is to study behavior of shear wall flat slab interaction under the seismic loads. For this, multi-storey buildings are considered. In a multi-storey building to reduce column shear and storey drift, shear wall is provided at some specific locations and here main objective to analyze the structural behavior of the structural configuration with respect to interaction of shear wall and flat slab.An extensive survey and review of the literature on the response and behavior of shear wall flat slab interaction under seismic loading is performed.

In this attempt, following main cases will be analyzed:

Frame 1. Conventional R.C.C. structure without shear wall.(with length increased by 50 m)
Frame 2. Conventional R.C.C. structure with Flat slab.(with length increased by 50 m)
Frame 3. Shear wall core type with flat slab (Placings-1).(with length increased by 50 m)
Frame 4. Shear wall core type with flat slab (Placings-2).(with length increased by 50 m)
Frame 5. C shaped shear wall with flat slab (Placings-1).(with length increased by 50 m)
Frame 6. C shaped shear wall with flat slab (Placings-2).(with length increased by 50 m)
Frame 7. L shaped shear wall at corners with flat slab.(with length increased by 50 m)
Frame 8. Parallel shear wall along periphery with flat slab.(with length increased by 50 m)
Frame 9. Non-Parallel shear wall along periphery with flat slab.(with length increased by 50 m)
Frame 10.+ Shaped shear wall at center with flat slab.(with length increased by 50 m)
Frame 11.E Shaped shear wall with flat slab (Placings-1).(with length increased by 50 m)
Frame 12.E Shaped shear wall with flat slab (Placings-2).(with length increased by 50 m)

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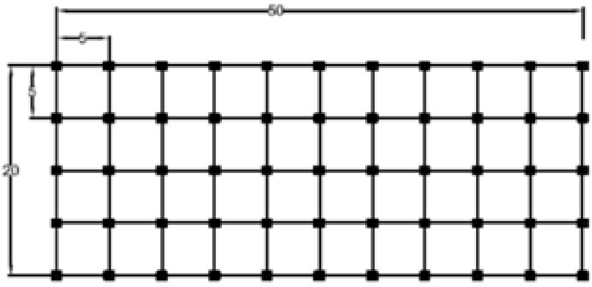
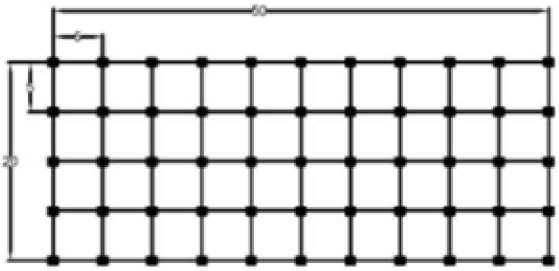
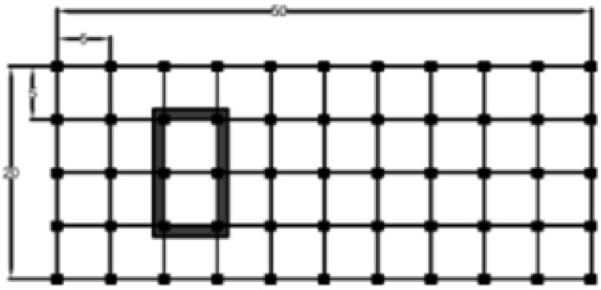


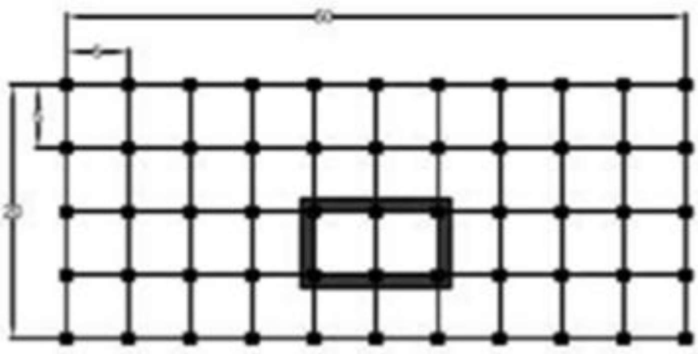
Frame 1
Simple Bare Frame



Frame 2
Bare Frame With Flat
Slab



Frame 3
Shear Wall Core Type
With Flat Slab
Placing -1



Frame 4
Shear Wall Core Type
With Flat Slab
Placing -2

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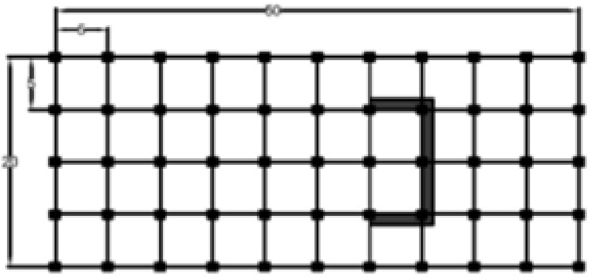
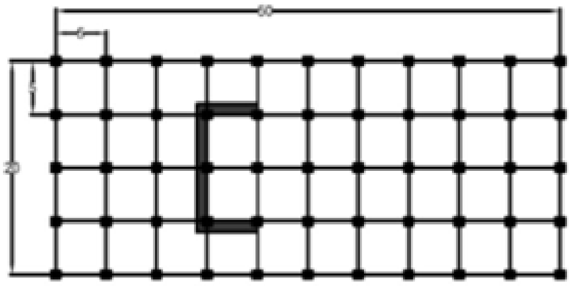
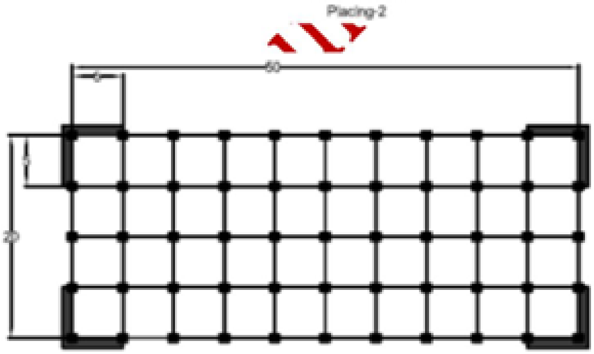


Frame 5
C Shaped Shear Wall
With Flat Slab
Placing-1



Frame 6
C Shaped Shear Wall
With Flat Slab
Placing-2



Frame 7
L Shaped Shear Wall
At Corners With Flat

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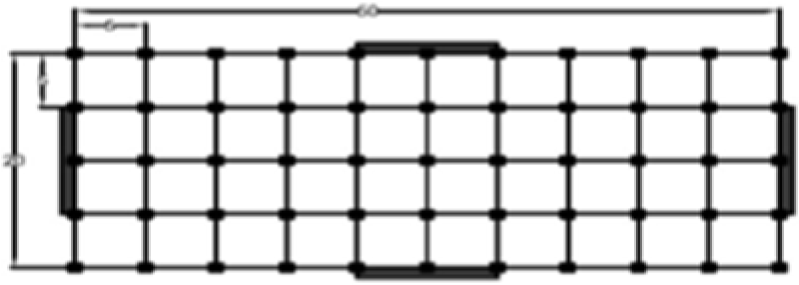
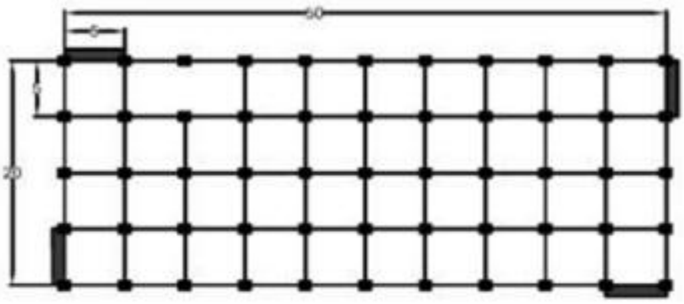
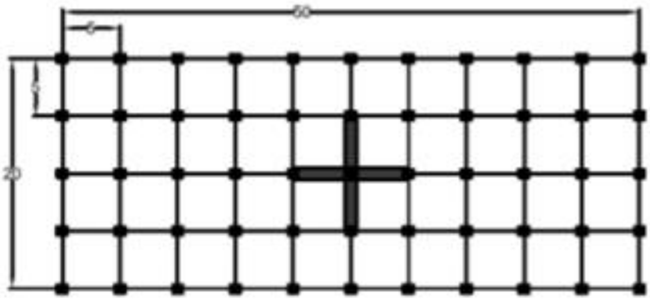


Frame 8
Parallel Shear Wall
Along Periphery With
Flat Slab



Frame 9
Non Parallel Shear
Wall Along Periphery
With Flat Slab



Frame 10
+ Shaped Shear Wall
At Centre With Flat
Slab

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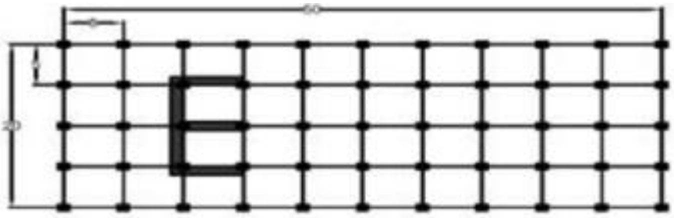
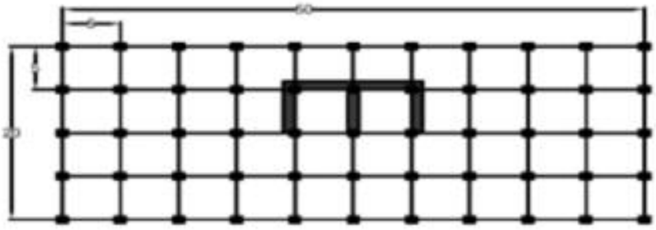


Frame 11
E Shaped Shear Wall
With Flat Slab
Placing-1



Frame 12
E Shaped Shear Wall
With Flat Slab
Placing-2

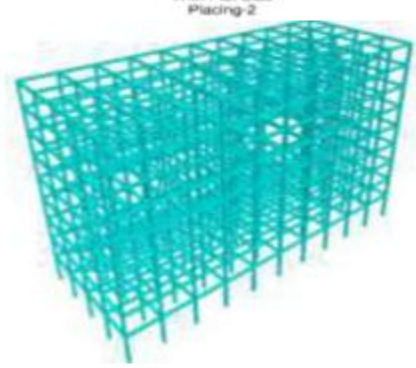


Fig. 1 3-D View of Conventional RCC Structure

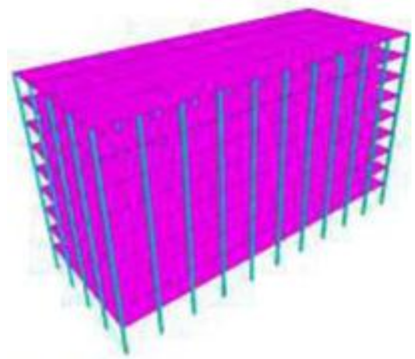


Fig. 2 3-D View of Flat slab structure

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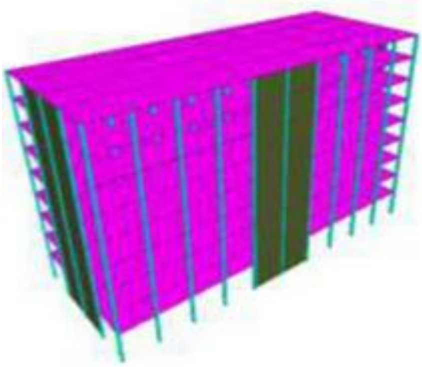

Fig. 1 3-D View of, Flat slab structure with shear wall

Load consideration

1. **Dead load-** Dead Load in a building should be comprised of weight of all walls, partition, floors, roofs and should include the weight of all other permanent construction in that building. Dead Load for design purpose is assessed as per IS 875:1987 (part I). In this study, dead load is taken as self-weight by software itself.
2. **Live load-** Live Load on floor should be comprised of all loads other than dead load. Live Load for design purpose is assessed as per IS875:1987 (part II). In this study, live loads on all floor slabs: 4KN/m^2. For determining the moments of column, allowance for reduction in live load is considered.
3. **Earthquake load-** Earthquake design is done in accordance with IS 1893 (part I):2002 and has been taken by specifying the zone in which structure is located. These RC framed building is located in zone V. The parameter to be used for analysis and design are given below:-

Table 2.1- Earthquake Parameters

Zone factor (Z)	V	0.36
Response Reduction factor (RF)	SMRF	5
Importance factor	All general building	1
Rock/Soil type	Medium soil	2
Type of structure	RC frame building	1
Damping Ratio		5%
Fundamental natural period of vibration (T_a) (For RCC Frame building with beams)		$0.09*h/(d)^{0.5}$
Fundamental natural period of vibration (T_a) (For RCC Frame building without beams)		$0.075*(h)^{0.75}$

Load combination

Following load combinations with the appropriate partial safety factor satisfying IS code provision i.e. IS 456:2000, table 18, clause 18.2.3.1 and IS 1893:2002, clauses 6.3.2.1 are as follows:-

1. 1.5(DL + LL)
2. 1.2(DL + LL + EQX)
3. 1.2(DL + LL - EQX)
4. 1.2(DL + LL + EQZ)
5. 1.2(DL + LL - EQZ)
6. 1.5(DL + EQX)

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7. 1.5(DL - EQX)
8. 1.5(DL + EQZ)
9. 1.5(DL - EQZ)
10. 0.9DL + 1.5EQX
11. 0.9DL - 1.5EQX
12. 0.9DL + 1.5EQZ
13. 0.9DL - 1.5EQZ

Modeling Of Structures

The main objective of the analysis is to study the different forces acting on a building with different combinations according to IS 1893 (Part 1) : 2002. The analysis is carried out in STAAD PRO V8i software. Results obtained of conventional R.C.C. structure i.e. slab, beam and column and flat slab R.C.C. structure with different combinations of shear wall for different heights according to storey are discussed in this work.

Conventional R.C.C. structure and flat slab R.C.C. are modeled and analyzed for the different combinations of static loading. These R.C.C. buildings are situated in seismic zone V.

Details of the buildings and member properties considered according to following assumptions are:-

The heights of buildings are kept as 29.80m, 58.60m, 87.40m and 116.12m from the ground. These buildings are of 9 storeyed, 18 storeyed, 27 storeyed and 36 storeyed respectively. The height of ground floor is 4.20m and above this 3.20m height follows for each storey. For different results, there is a comparison of 12 numbers of modals and analyzed accordingly.

A. The different components of conventional R.C.C. structure are as follows:-

Columns ofthe building are of 230mm x 450mm.

Beams size of the building is of 230mm x 400mm. Slab thickness of the building is of 125mm.

B. Similarly the different components of flat slab structures are as follows :-

Columns of the building are of 230mm x 450mm
Slab thickness of the building is of 125mm.
Shear wall thickness is of 250mm with a clear cover of 50mm.

CALCULATIONS AND RESULTS

(A) Fundamental Natural Period(x direction)(second)

The approximate fundamental natural periodof vibration (Ta**,** in seconds, of a moment-resistingframe building may be calculated to maximum values in comparison of different height of building with different frames is computed as :-

$T_a = 0.075\ h^{0.75}$ for RC buildings with beams.

$T_a = 0.09h/\ d^{0.5}$ for RC buildings without beams.

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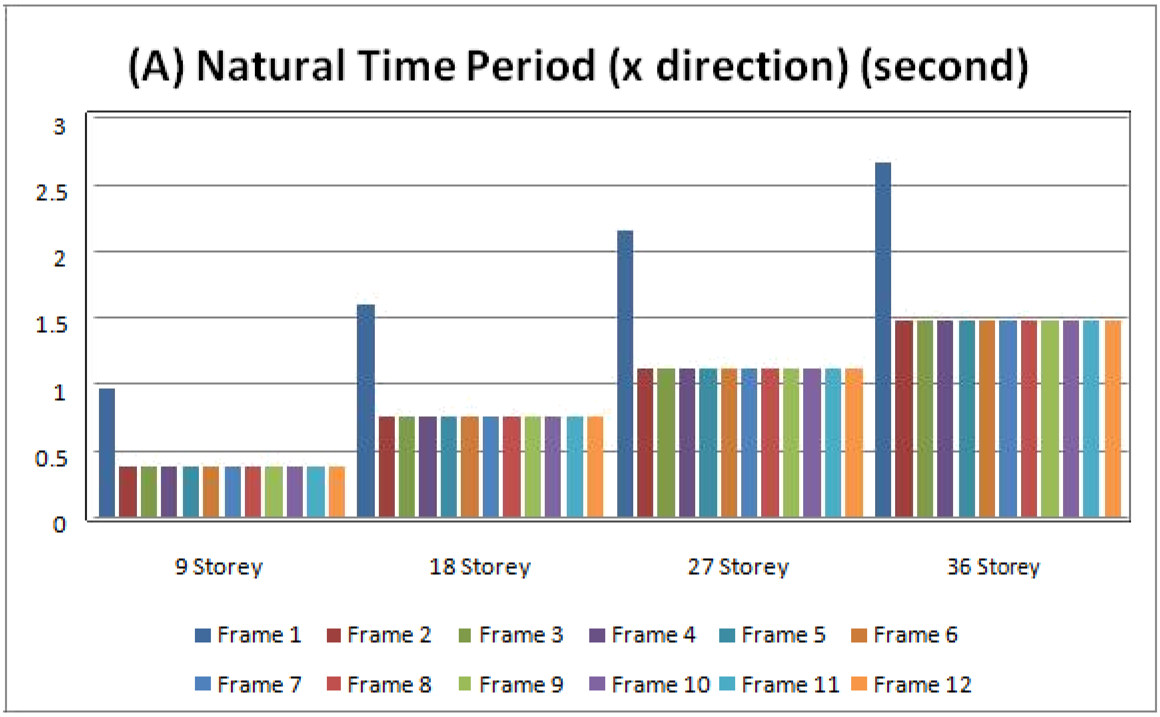
Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	0.956	0.379	0.379	0.379
2	58.6	18	1.588	0.7458	0.7458	0.7458
3	87.4	27	2.1438	1.1124	1.1124	1.1124
4	116.2	36	2.6544	1.4789	1.4789	1.4789
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 5)		(Frame 7)	(Frame 8)
1	29.8	9	0.379	9	0.379	0.379
2	58.6	18	0.7458	.7458	0.7458	0.7458
3	87.4	27	1.1	1.1124	1.1124	1.1124
4	116.2			1.4789	1.4789	1.4789
Sno.	Height Of Building (m)	Storey	(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	0.379	0.379	0.379	0.379
2	58.6	18	0.7458	0.7458	0.7458	0.7458
3	87.4	27	1.1124	1.1124	1.1124	1.1124
4	116.2	36	1.4789	1.4789	1.4789	1.4789



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(B) Fundamental Natural Period(z direction)(second)

The approximate fundamental natural periodof vibration (Ta**)**, in seconds, of a moment-resistingframe building may be calculated to maximum values in comparison of different height of building with different frames is computed as :-

$T_a = 0.075\ h^{0.75}$ for RC buildings with beams.
$T_a = 0.09h/\ d^{\ 0.5}$ for RC buildings without beams.

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	0.956	0.599	0.599	0.599
2	58.6	18	1.588	1.1793	1.1793	1.1793
3	87.4	27	2.1438	1.7589	1.7589	1.7589
4	116.2	36	2.6544	2.3384	2.3384	2.3384
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)
1	29.8	9	0.599	0.599	0.599	0.599
2	58.6	18	1.1793	1.1793	1.1793	1.1793
3	87.4	27	1.7589	1.7589	1.7589	1.7589
4	116.2	36	2.3384	2.3384	2.3384	2.3384
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	0.599	0.599	0.599	0.599
2	58.6	18	1.1793	1.1793	1.1793	1.1793
3	87.4	27	1.7589	1.7589	1.7589	1.7589
4	116.2	36	2.3384	2.3384	2.3384	2.3384

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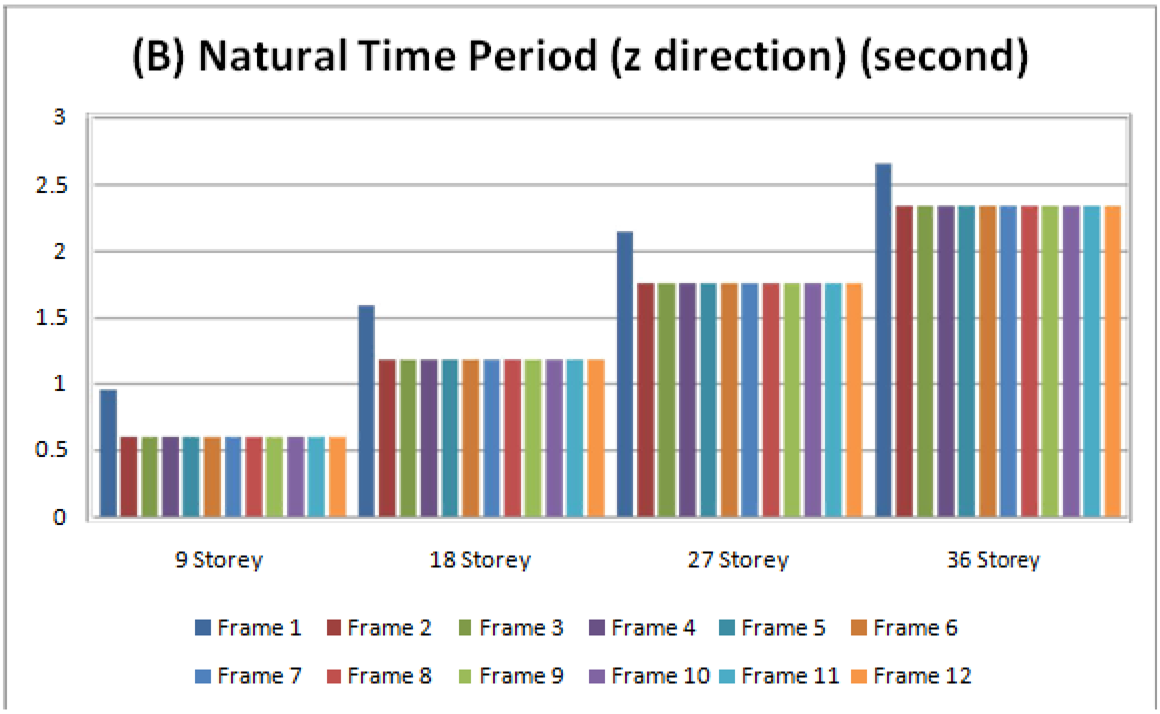

(C) Average Response Acceleration Coefficient (Sa/g)(x direction)

Average response accelerationcoefficient is a factor denoting the acceleration response spectrum of the structure subjected to earthquake ground vibrations, and depends on natural period of vibration and damping of the structure to maximum values in comparison of different height of building with different frames is computed as :-

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	1.423	2.5	2.5	2.5
2	58.6	18	0.856	1.824	1.824	1.824
3	87.4	27	0.634	1.223	1.223	1.223
4	116.2	36	0.512	0.92	0.92	0.92
Sno.	Height Of	No. Of	Flat Slab With Different Shear Wall Placings			

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	Building (m)	Storey	(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)
1	29.8	9	2.5	2.5	2.5	2.5
2	58.6	18	1.824	1.824	1.824	1.824
3	87.4	27	1.223	1.223	1.223	1.223
4	116.2	36	0.92	0.92	0.92	0.92

Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	2.5	2.5	2.5	2.5
2	58.6	18	1.824	1.824	1.824	1.824
3	87.4	27	1.223	1.223	1.223	1.223
4	116.2	36	0.92	0.92	0.92	0.92

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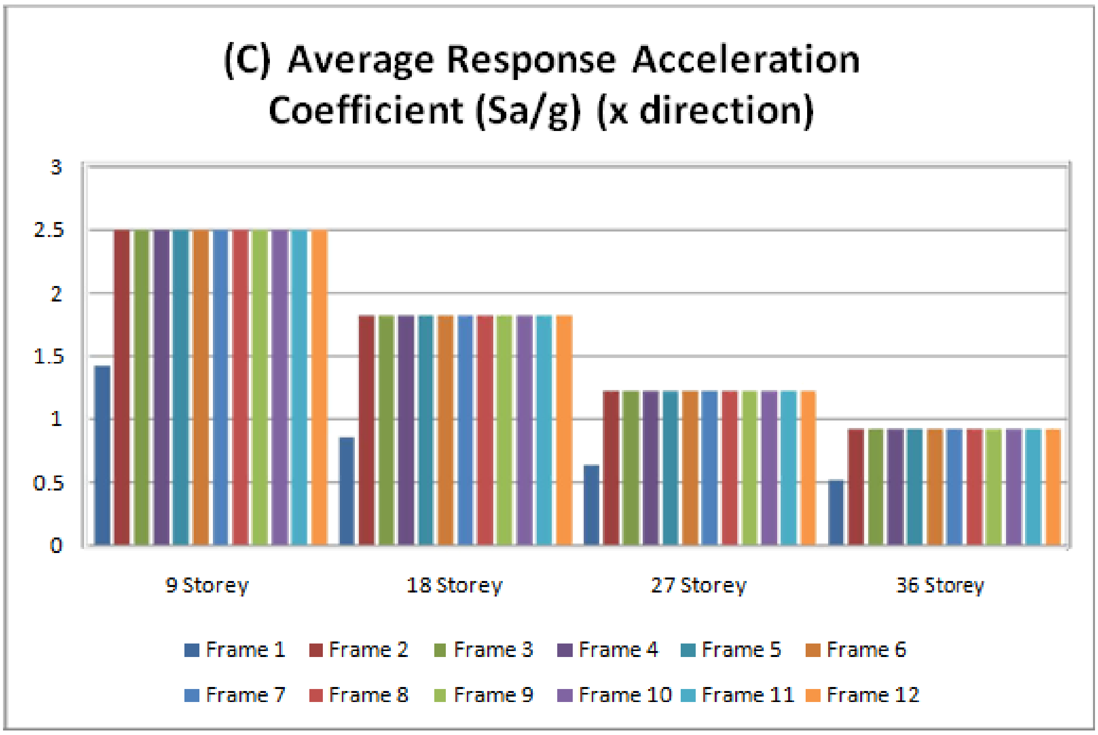

(D) Average Response Acceleration Coefficient (Sa/g)(z direction)

Average response accelerationcoefficient is a factor denoting the acceleration response spectrum of the structure subjected to earthquake ground vibrations, and depends on natural period of vibration and damping of the structure to maximum values in comparison of different height of building with different frames is computed as

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	1.423	2.27	2.27	2.27
2	58.6	18	0.856	1.153	1.153	1.153
3	87.4	27	0.634	0.773	0.773	0.773
4	116.2	36	0.512	0.582	0.582	0.582
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)

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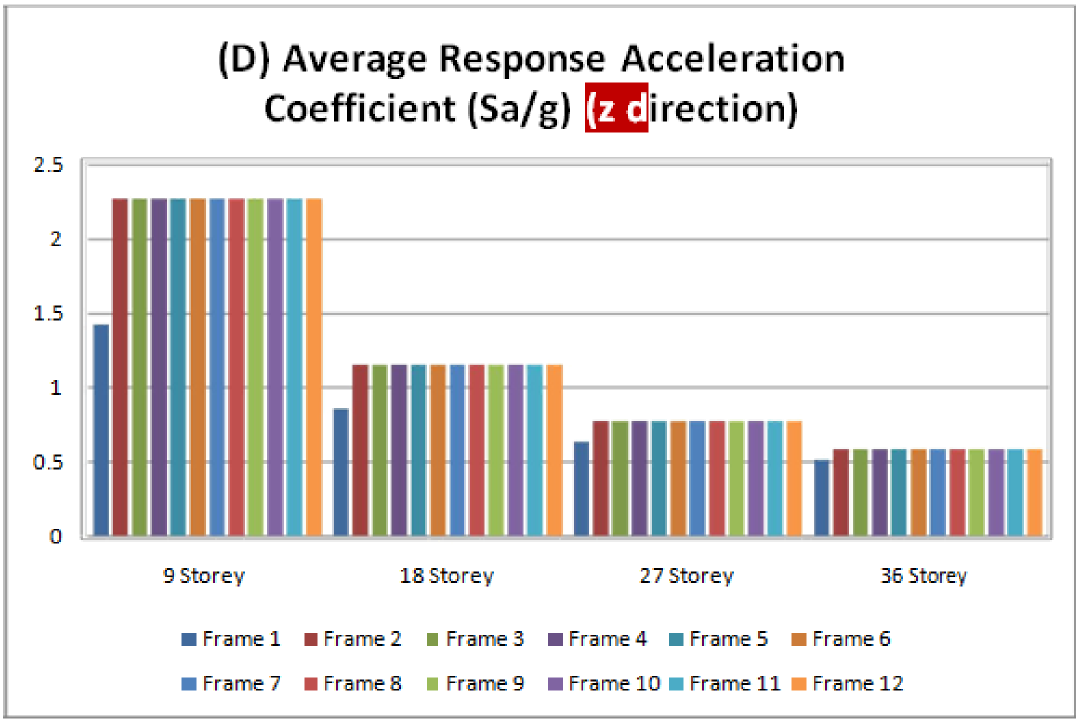
1	29.8	9	2.27	2.27	2.27	2.27
2	58.6	18	1.153	1.153	1.153	1.153
3	87.4	27	0.773	0.773	0.773	0.773
4	116.2	36	0.582	0.582	0.582	0.582

Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	2.27	2.27	2.27	2.27
2	58.6	18	1.153	1.153	1.153	1.153
3	87.4	27	0.773	0.773	0.773	0.773
4	116.2	36	0.582	0.582	0.582	0.582



(E) Base Shear (x direction)

The total design lateral forces or design seismic base shear (Vb) along any principal direction to maximum values in comparison of different height of building with different frames shall be determined by the following expression :-

$$Vb = AhW$$

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Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	6248.036	2745.333	2982.304	2982.304
2	58.6	18	7954.459	3996.187	4336.088	4336.088
3	87.4	27	8769.775	4015.866	4355.748	4355.748
4	116.2	36	9222.427	4026.062	4365.957	4365.957
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)
1	29.8	9	2903.314	2903.314	3061.294	3.61.294
2	58.6	18	4222.788	4222.788	4449.388	4449.388
3	87.4	27	4242.454	4242.454	4469.041	4469.041
4	116.2	36	4252.659	4252.659	4479.255	4479.255
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	2903.314	2903.314	2942.809	2942.809
2	58.6	18	4222.787	4222.787	4279.438	4279.438
3	87.4	27	4242.454	4242.454	4299.101	4299.101
4	116.2	36	4252.659	4252.659	4309.308	4309.308

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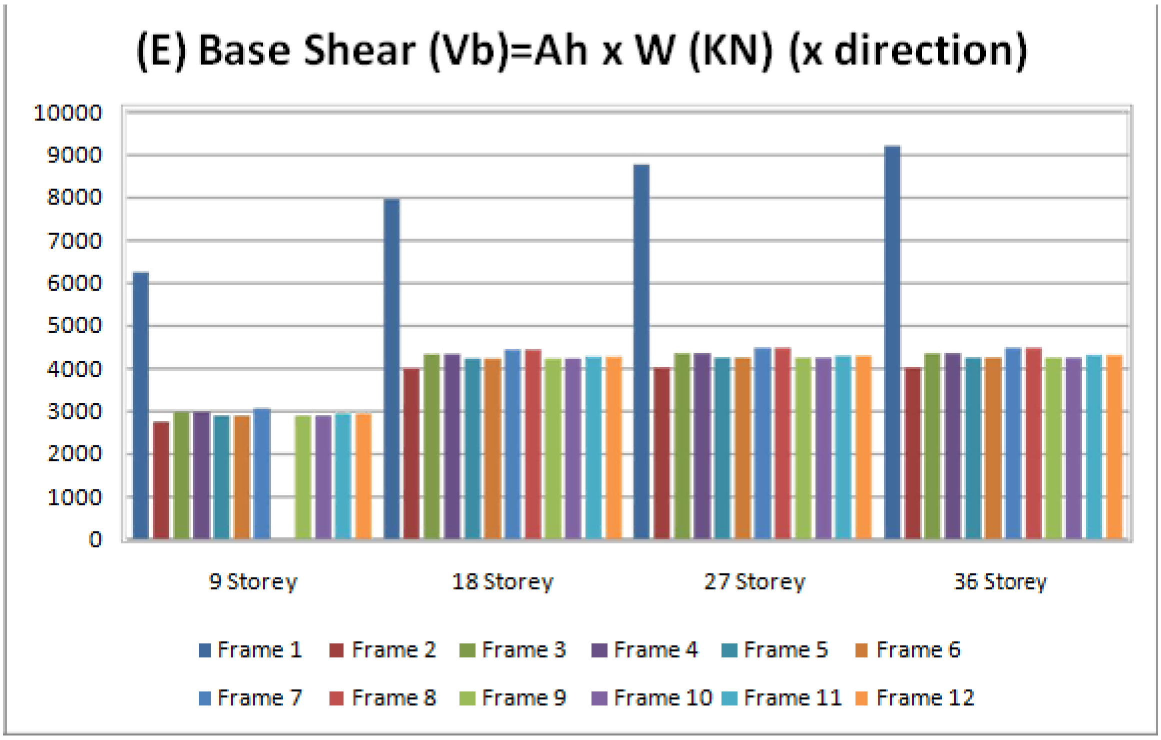

(F) Base Shear(z direction)

The total design lateral forces or design seismic base shear (Vb) along any principal direction to maximum values in comparison of different height of building with different frames shall be determined by the following expression :-

$$Vb = AhW$$

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	6248.036	2493.256	2708.47	2708.47
2	58.6	18	7954.459	2527.224	2742.181	2742.181
3	87.4	27	8769.775	2539.797	2754.752	2754.752
4	116.2	36	9222.427	2546.247	2761.21	2761.21
Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)

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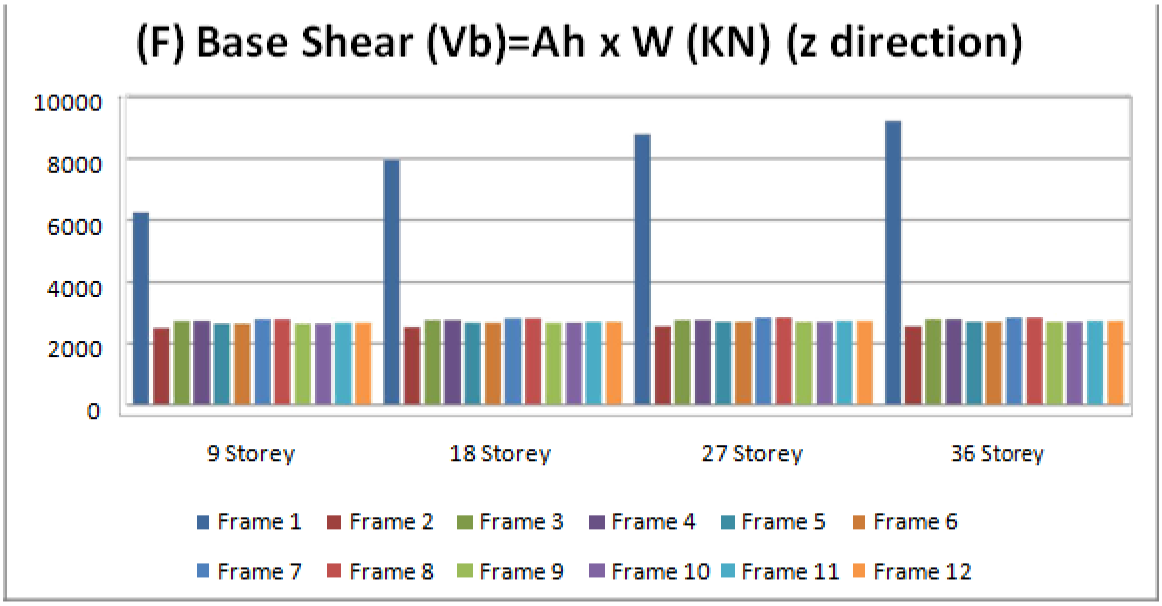
1	29.8	9	2636.733	2636.733	2780.207	2780.207
2	58.6	18	2670.529	2670.529	2813.833	2813.833
3	87.4	27	2683.101	2683.101	2826.404	2826.404
4	116.2	36	2689.556	2689.556	2832.865	2832.865

Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	2636.733	2636.733	2672.602	2672.602
2	58.6	18	2670.529	2670.529	2706.355	2706.355
3	87.4	27	2683.101	2683.101	2718.926	2718.926
4	116.2	36	2689.556	2689.556	2725.383	2725.383



(G) Sway (mm)

Storey is the space between two adjacent floor and sway is the displacement of one level relative to the other level above or below according to maximum values in comparison of different height of building with different frames is computed as :-

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Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure (Frame 1)	Flat Slab Structures (Frame 2)	Flat Slab With Different Shear Wall Placings (Frame 3)	(Frame 4)
1	29.8	9	1002.397	305.606	81.129	60.97
2	58.6	18	2578.677	866.01	378.314	255.449
3	87.4	27	4285.718	1332.407	801.378	542.497
4	116.2	36	5995.75	1832.159	1332.435	925.307
Sno.	**Height Of Building (m)**	**No. Of Storey**	**Flat Slab With Different Shear Wall Placings (Frame 5)**	**(Frame 6)**	**(Frame 7)**	**(Frame 8)**
1	29.8	9	171.122	171.122	78.551	68.258
2	58.6	18	544.322	544.324	399.923	327.303
3	87.4	27	1093.224	1093.226	850.004	700.579
4	116.2	36	1706.081	1706.083	1380.333	1149.562
Sno.	**Height Of Building (m)**	**No. Of Storey**	**Flat Slab With Different Shear Wall Placings (Frame 9)**	**(Frame 10)**	**(Frame 11)**	**(Frame 12)**

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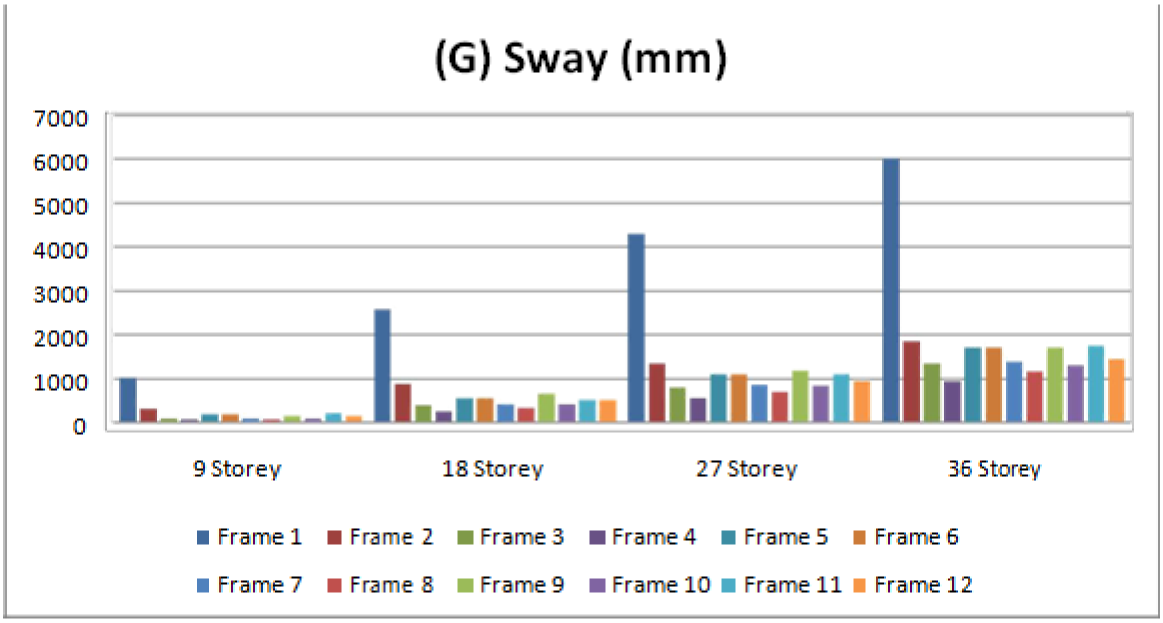
1	29.8	9	138.133	84.824	199.922	140.864
2	58.6	18	650.887	410.07	514.552	503.048
3	87.4	27	1171.403	827.238	1082.97	922.746
4	116.2	36	1705.285	1304.154	1745.775	1443.414



(H) Shear Force (KN)

Shear force at a section of a beam is defined as algebraic sum of all the forces acting on one side of the section. Calculated value of shearing forces according to different variations in storey height with different frames is computed as:-

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	261.312	105.982	70.303	60.881
2	58.6	18	310.293	-157.345	-157.066	-124.307
3	87.4	27	-345.235	176.78	-291.34	-225.907
4	116.2	36	350.614	194.742	-434.108	338.993

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Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)
1	29.8	9	68.202	-68.202	59.985	65.131
2	58.6	18	-151.403	151.403	-136.746	143.891
3	87.4	27	-281.323	281.322	215.034	281.382
4	116.2	36	-392.373	392.372	-318.677	412.594

Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	69.177	-65.924	-74.094	60.791
2	58.6	18	144.09	142.904	-165.65	-123.629
3	87.4	27	-215.108	204.864	-268.109	212.952
4	116.2	36	316.524	299.671	-390.07	-319.939

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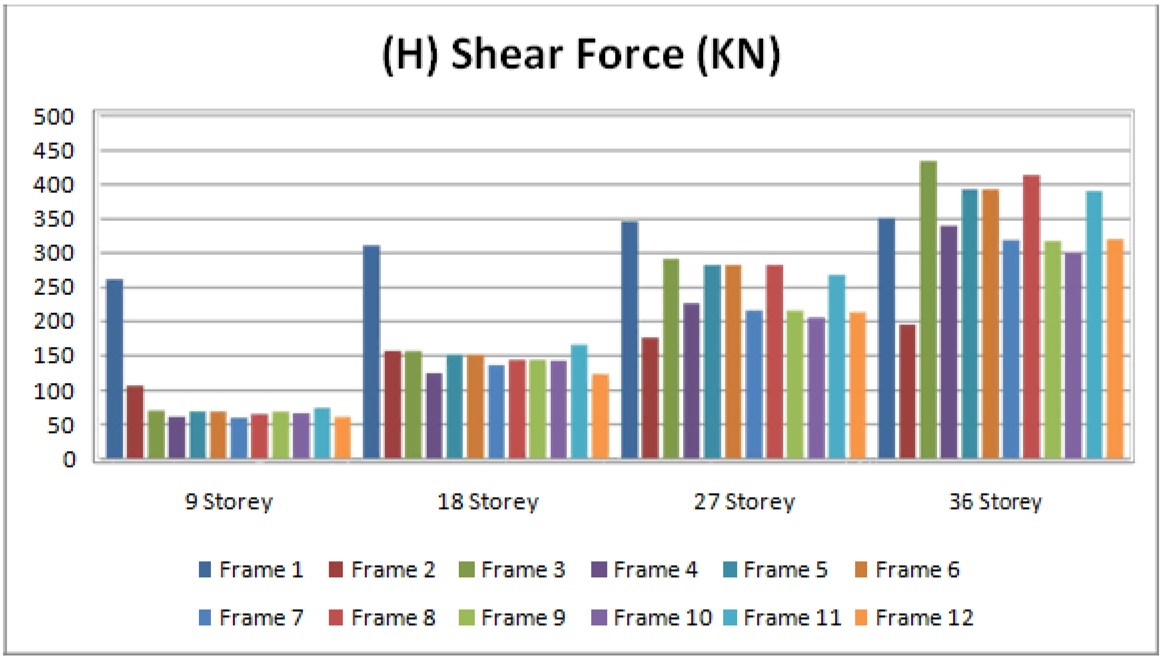

(I) Moment (KN-m)

Bending Moment at a section of a beam is defined as algebraic sum of the moment of all the forces acting on one side of the section. Calculated value of Bending Moment according to different variations in storey height with different frames is computed as:-

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	461.939	-187.817	-24.093	100.762
2	58.6	18	587.832	273.854	257.542	-205.976
3	87.4	27	658.247	-283.797	514.543	-398.166
4	116.2	36	704.291	312.452	764.209	-592.969
Sno.	Height Of	N	Flat Slab With Different Shear Wall Placings			

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	Building (m)	o. Of St orey	(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)
1	29.8	9	-124.116	124.116	103.364	155.915
2	58.6	18	272.146	-272.146	235.354	241.543
3	87.4	27	505.69	-505.69	-371.876	-491.009
4	116.2	36	692.236	-692.234	-558.466	720.326

Sno.	Height Of Building (m)	No. Of Storey	Flat Slab With Different Shear Wall Placings			
			(Frame 9)	(Frame 10)	(Frame 11)	(Frame 12)
1	29.8	9	-134.926	-113.355	128.099	102.334
2	58.6	18	-282.006	-248.27	286.742	207.774
3	87.4	27	356.203	-340.775	483.888	-373.855
4	116.2	36	542.312	498.059	697.288	560.531

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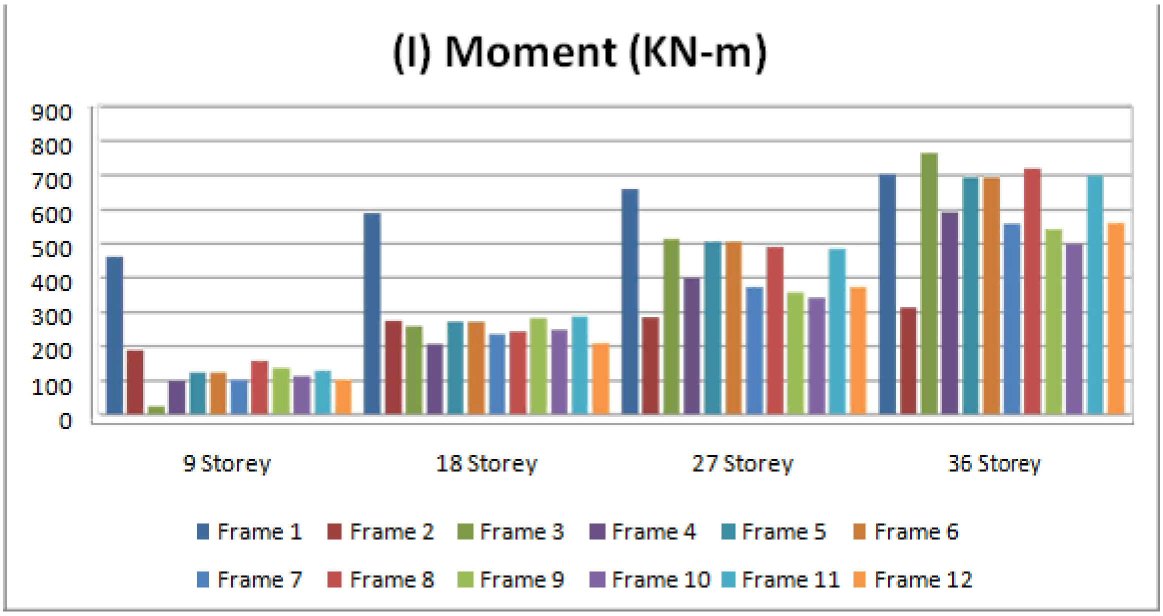
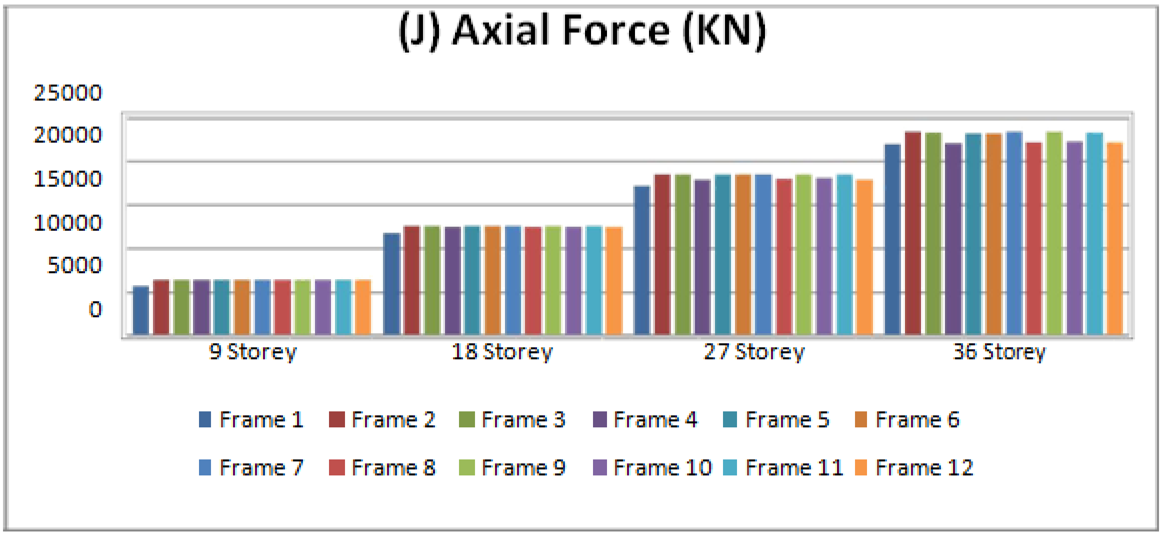


(J) Axial Force (KN)

In an axial-force member, the stresses and strains are uniformly distributed over the cross section. Hence for the calculation of the axial forces in member we have to consider forces in x-z plane when upward global direction is y.Calculated value of axial-force according to different variations in storey height with different frames is computed as:-

Sno.	Height Of Building (m)	No. Of Storey	Conventional Bare Frame Structure (Frame 1)	Flat Slab Structures (Frame 2)	Flat Slab With Different Shear Wall Placings (Frame 3)	(Frame 4)
1	29.8	9	5637.702	6357.962	6363.821	6379.404
2	58.6	18	11773.07	12488.44	12494.21	12410.54
3	87.4	27	17210.6	18536.33	18502.33	17919.1
4	116.2	36	21957.9	23492.61	23296.09	22088.61
Sno.	Height Of Building	No. Of St	Flat Slab With Different Shear Wall Placings			

	(m)	orey	(Frame 5)	(Frame 6)	(Frame 7)	(Frame 8)
1	29.8	9	6358.109	6358.112	6373.149	6378.497
2	58.6	18	12495.68	12495.69	12485.02	12423.49
3	87.4	27	18473.65	18473.66	18535.07	18007.72
4	116.2	36	23178.44	23178.45	23443.94	22145.65
Sno.	**Height Of Building (m)**	**No. Of Storey**	**Flat Slab With Different Shear Wall Placings**			
			(Frame 9)	**(Frame 10)**	**(Frame 11)**	**(Frame 12)**
1	29.8	9	6366.012	6367.784	6358.307	6377.998
2	58.6	18	12486.62	12429.56	12492.61	12414.91
3	87.4	27	18535.75	18035.92	18502.79	17943.66
4	116.2	36	23465.34	22316.31	23307.05	22144.48



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(K) Torsion (KN-m)

Torsion, also known as torque, describes a moment that is acting upon an object around the same axis in which the object lies. A moment is a measurement of the propensity of a force to create motion around either a point or an axis, and is calculated as the force upon the object multiplied by the distance of the force from the chosen origin. Calculated value of torqueaccording to different variations in storey height with different frames is computed as:-

Sno.	Height Of Building (m)	No . Of Sto rey	Conventional Bare Frame Structure	Flat Slab Structures	Flat Slab With Different Shear Wall Placings	
			(Frame 1)	(Frame 2)	(Frame 3)	(Frame 4)
1	29.8	9	5.368	0.199	0.827	0.334
2	58.6	18	8.417	0.289	0.71	0.419
3	87.4	27	9.39	0.291	0.62	0.382
4	116.2	36	10.83	0.292	0.546	0.352
Sno.	**Height Of Building (m)**	**No . Of Sto rey**	**Flat Slab With Different Shear Wall Placings**			
			(Frame 5)	**(Frame 6)**	**(Frame 7)**	**(Frame 8)**
1	29.8	9	1.57	1.57	0.944	0.399
2	58.6	18	1.524	1.524	0.584	0.324
3	87.4	27	1.448	1.448	0.587	0.519
4	116.2	36	1.402	1.402	0.649	0.843
Sno.	**Height Of Building (m)**	**No . Of Sto rey**	**Flat Slab With Different Shear Wall Placings**			
			(Frame 9)	**(Frame 10)**	**(Frame 11)**	**(Frame 12)**

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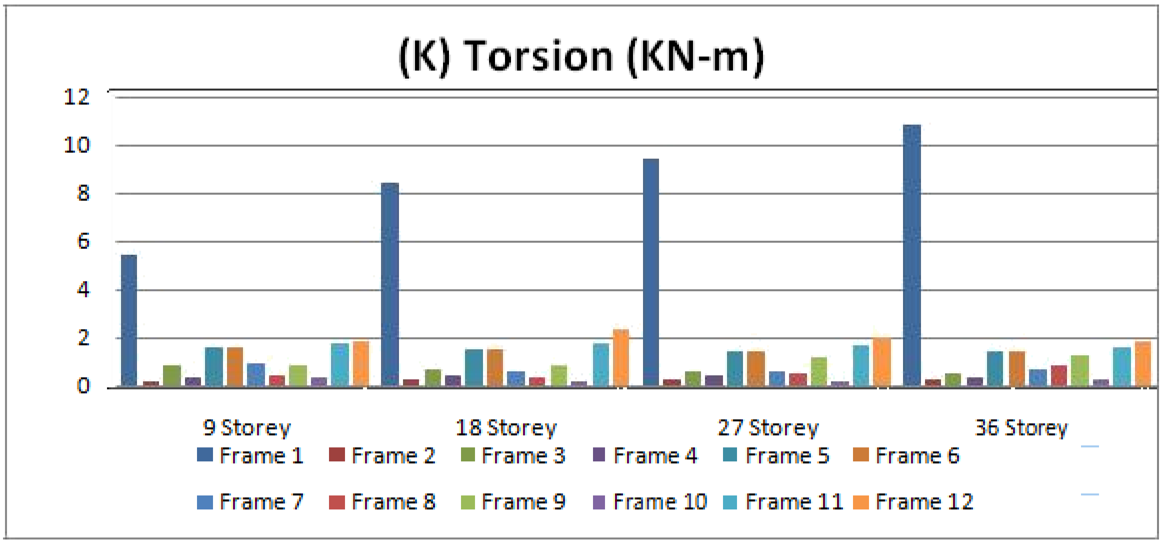
1	29.8	9	0.865	0.311	1.758	1.835
2	58.6	18	0.871	0.196	1.722	2.366
3	87.4	27	1.2	0.198	1.659	2.034
4	116.2	36	1.225	0.222	1.611	1.856



CONCLUSION

This paper presents a summary of the study, for conventional R.C.C. building, R.C.C. flat slab building and R.C.C. flat slab building with differentvariations in storey height with different frames. The effect of seismic load has been studied for the two types of building with different height and with only one side of the plan is extended viz. length(50 m). On the basis of the results following conclusions have been drawn:

- The natural time period increases as the height of the building increases, since the values are represented by the help of tabular graphs, concluding that all the frames are having same values for different storey computations, it increases according to height though the major change is increased value of Frame 1 only and other values are samewhen there is more length and less width.
- Computing the values in z direction, the values of the natural time period shows that when the height of the building increases the values are trying to become same when there is less width and more length.
- Average Response Acceleration Coefficient (Sa/g)decreases as the height of the building increases, since the values are represented by the help of tabular graphs, concluding that all the frames are having same values for different storey computations; it decreases according to height though the major change is decreased value of Frame 1 only for x direction computations.
- Computing the values in z direction, the values of Average Response Acceleration Coefficient (Sa/g) are trying to become same when there is less width and more lengthfor z direction computations.
- Design seismic base shear (Vb) is high in Frame 1 onlyand low in Frame-2 thoughthere is a slight change in the values of different storey. The high base shear case is of 36 storey Frame 1 and the low base shear is of 9 storey frame 2for x direction computations.
- Computing the values in z direction, the values of Design seismic base shear for the frames 2 to frame 12 are same though the values of frame 1 increases according to base height for z direction computations.

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- The values of Sway is clearly said that if moving towards the high storey buildings there is always sway though this paper concludes that if we are providing a structure according to frame 1 there is a lot of sway. Contrasting to this value having a minimum value from all the results in a particular storey is of sway in Frame 4 and the values are taken for the maximum case only.
- Shear force is increasing according to the height of the structure. Hence the maximum value is seen in 36 storey frame 3 and the minimum value is of 36 storey Frame 2and the values are taken for the maximum case only.
- The Bending Moment seems to be maximum in 36 storey building. Frame 3 having the maximum values and frame 2 is having the minimum values of Momentand the values are taken for the maximum case only.
- Axial force is also increasing on comparing the storey of different height. The maximum value is seems overall to be in frame 1 and its minimum value seems to be frame 10 and the values are taken for the maximum case only.
- Last but not the least the important value used in the analysis is the value of Torsion i.e. the applied torque. Values also conclude that if moving towards more floors, there is always a greater value of torsion.Maximum value seems to be in Frame 1 and the minimum value seems to be in Frame 10 and the values are taken for the maximum case only

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