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OPTIMIZATION OF BUILDING FRAMES WITH VARIOUS PLANS WITH VARIOUS POSITIONS OF SHEAR WALL

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CHAPTER 1

INTRODUCTION

1.1 General

Reinforced concrete (RC) buildings often have vertical plate-like RC walls called Shear Walls in addition to slabs, beams and columns. Their thickness can be as low as 150mmor as high as 400mm in high rise buildings. Shear walls are usually provided along bothlength and width of buildings. Shear walls are like vertically-oriented wide beams that carry the earthquake loads downwards to the foundation.

Properly designed and detailed buildings with shear walls have shown very good performance in past earthquakes. The overwhelming success of buildings with shear walls in resisting strongearthquakes is summarized in the quote: “We cannot afford to build concrete buildings meant to resist severe earthquakes without shear walls” by Mark Fintel, a noted consulting engineer in USA. Shear walls in high seismic regions require special detailing. However, in past earthquakes, even buildings with sufficient amount of walls that were not specially detailed for seismic performance (but had enough well-distributed reinforcement) were saved from collapse. Shear wall buildings are a popular choice in many earthquake prone countries, like Chile, New Zealand and USA. Shear walls are easy to construct, because reinforcement detailing of walls is relatively straight-forward and therefore easily implemented at site. Shearwalls are efficient, both in terms of construction cost and effectiveness in minimizing earthquake damage in structural and nonstructural elements (like glass windows and building contents)

Most RC buildings with shear walls also have columns; these columns primarily carry gravityloads i.e. those due to self-weight and contents of building). Shear walls provide large strengthand stiffness to buildings in the direction of their orientation, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large. Thus, design of their foundation requires special attention. Shear walls should be provided along preferably both length and width. However, if they are provided along only one direction, a proper grid of beams and columns in the vertical plane (called a moment-resistant frame) must be provided along the other direction to resist strong earthquake effects. Door or window openings can be provided in shear walls, but their size must be small to ensure least interruption to force flow through walls. Moreover, openings should be symmetrically located. Special design checks are required to ensure that the net cross-sectional area of a wall at an opening is sufficient to carry the horizontal earthquake force. Shear walls in buildings must be symmetrically located in plan to reduce ill-effects of twist in buildings. They could be placed symmetrically along one or both directions in plan. Shear walls are more effective when located along exterior perimeter of the building – such a layout increases resistance of the building to twisting.

The basic function of shear wall is to increase the rigidity for lateral load resistance along with providing adequate stiffness and strength to the structure. Shear wall is a structural system composed of shear panels to counter the effects of lateral load acting on the structure.

Reinforced concrete shear-wall buildings intensively used than other lateral force resisting systems due to their lower cost, fast construction and considerable stiffness efficiency. The lateral load resisting systems subjected to high level of dynamic energy raised from seismic loads behave nonlinearly and the capacity design concept will apply to capture the failure mechanism due to the formation of plastic hinges at sections of maximum straining actions. However, the current code's provisions doesn't distinguish between the requirements of the design of low, medium and high-rise buildings with shear wall lateral resisting elements and this may lead to undesirable results.

Shear wall is a structural system composed of shear panels to counter the effects of lateral load acting on the structure. Depending upon the earthquake zone, wind and seismic loads are the most common loads for which the shear walls are designed. The basic function of shear wall is to increase the rigidity for lateral load resistance along with providing adequate stiffness and strength to the structure. Reinforced concrete shear wall provide a significant amount of strength and stiffness to the building in the direction of their orientation which considerably reduces lateral sway of the building.

They are usually conceived as vertical plates supported at the foundation and are expected to function only under the action of in-plane horizontal and vertical forces. However, depending upon the architectural and structural layout of the building, shear walls may have a more complex shape. Often the walls are of a central core forming boxes, or are cast between two columns leading to I or dumbbell shapes. Shear wall must meet appropriate criteria for strength, stiffness and in earthquake areas, also for ductility. Depending on the moment to shear ratio at each horizontal cross section of the wall, the behavior can be controlled by shear and flexure.

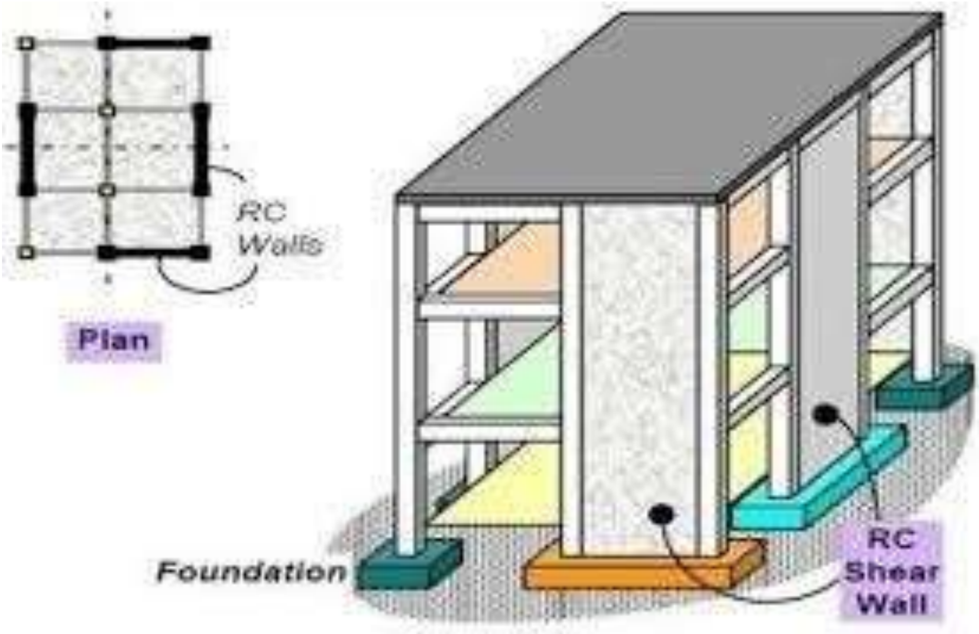


Fig 1.1 R C shears wall location.

1.2 Aim and Research Objective

Aim:

To Analysis the optimization of building frames with various plans with various positions of shear wall.

Research Objective:

After exclusive study of literature carried by various researchers, the unfocused area is identified as problem for proposed dissertation to analyze the structures for Optimization of building frames with various plans with various positions of shear wall proposed to carry out using following points:

Dynamic analysis of building frames for various plans and various positions of shear wall.

Comparison of various parameters of building frames without and with shear walls for various position.

Finding out optimum percentage of shear wall and also finding suitable location of shear wall in various plans.

1.3 Scope of the Project Work

In India, very few buildings are designed properly by structural engineers. Proper analysis and design of building structures that are subjected to static and dynamic loads is very important. Another important factor in the analysis of these systems is obtaining acceptable accuracy in the results. The object of this study is to model and analyze shear wall-frame structures having regular and irregular shear wall in the structure and we will also discuss various factor considered in model analysis.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction:

Several investigators studied the influence of shear wall on buildings. They performed the studies by changing various parameters of shear wall structure and found that due to the flexibility structural forces are altered. Some of noteworthy configuration of researchers in this field is discussed below.

2.2 Review:

Mr. K. LovaRaju [Jan-2015] conducted non-linear analysis of frames to identify effective position of shear wall in multi- storey building. An earthquake load was applied toan eight-storey structure of four models with shear wall at different location in all seismic zones using ETABS. Push over curves were developed and has been found the structure with shear wall at appropriate location is more important while considering displacement and base shear.

Syed. M. Katami [May-2018] presented the results of time history analysis which addressed the effect of openings in shear walls near- fault ground motions. A Complete building, shear walls with square opening in the center and shear wall with opening at right end side were considered. From the results it was observed that shear walls with openings experienced a decrease in terms of strength.

Dr. B. Kameshwari [Oct 2011] Analyzed the influence of drift and inter storey drift of the structure on various configuration of shear wall panels on high rise structures. The bare frame was compared with various configurations like i) Conventional shear wall ii) Alternate arrangement of shear wall iii) Diagonal arrangement of shear wall iv) Zig Zag arrangement of shear wall v) Influence of lift core shear wall. From the study, it was found that Zig Zag shear wall enhanced the strength and stiffness of structure compared to other types. In earthquake prone areas, diagonal shear wall was found to be effective for structures.

Nanjma Nainan [May 2012] Conducted analytical study on dynamic response of seismic resistant building frames. The effects of change in height of shear wall on storey displacement in the dynamic response of building frames were obtained. From the study, itwas concluded that it is sufficient to raise the shear wall up to the mid height of building frames instead of raising up to entire height of the building.

Shahzad Jamil Sardar [Sep 2013] Modelled a 25-storey building zone V and analyzed by changing the location of shear wall to determine various parameters like storey drift, storey shear and displacement using ETABS. Both static and dynamic analysis was done to determine and compare the base shear. Compared to other models, when shear wall placed at center and four shear walls placed at outer edge parallel to X and Y direction model showed lesser displacement.

Eshan Salami Firoozabad [July 2021] determined the shear wall configuration on seismic performance of building. The top storey displacements for different configurations were obtained using SAP 2000. From the study it was observed that the top storey drift can bereduced by changing the location of shear wall and it was suggested that the quantity of shear wall could not influence the seismic behavior of buildings.

Varsha. R. Harne [May 2014] considered a six storey RCC building which is subjected to earthquake loading in zone II to determine the strength of RC wall by changing the location of shearwall using STAAD.Pro. Seismic coefficient method is used to calculate the earthquakeload as per IS 1893 – 2002 (Part I). Four different models like structure without shear wall, structure with L type shear wall, structure with shear wall along periphery, structure with cross type shear wall were modeled for analysis. Compared to other models, the shear force and bending moment, for structure with shear wall along the periphery is found to be maximum at the ground level and wall provided along the periphery of the structure is found to be more efficient than all other types of shear wall.

Shahabodin Zaregarizi [Oct. 2008] Conducted comparative investigation on using shear wall and infill to improve seismic performance of existing buildings. Static nonlinear analysis was done to compare the effectiveness of both methods. From the results, it was observed thatconcrete infills have considerable strength while brick one showed lower strength. On the contrary, brick infills accepted large displacement than concrete ones. It was concludedthat the combination of brick and concrete infills reduced the negative effects when they both used individually.

Chun Ni [2021] described the performance of shear walls with diagonal or transverse lumber sheathing. A total of 16 full-scale shear walls were tested to determine the effects of hold-owns, vertical load and width of lumber sheathing on in-plane shear capacity. The in-plane shear capacities of shear walls with double diagonal lumber sheathing are 2-3 times higher than that of shear walls with single diagonal lumber sheathing.

Michael R. Dupuis [May 2018] analyzed seismic performance of shear wall buildings with gravity-induced lateral demands using Open Sees software. The inelastic response of concrete shear wall buildings was investigated. From the result, it was demonstrated that a seismic ratcheting effect can develop and amplify inelastic displacement demands. But the effect is more prevalent in coupled shear walls than cantilevered shear walls.

Prof. Swati Ghuge and Prof. Monika T Zope [Feb. 2019] Multistorey buildings with open (soft storey) the ground floors are inherently vulnerable to collapse due to seismic loads, their constructions is still widespread in develop nations. Auxiliary outline and examination delivers the ability of opposing all the connected loads without failure amid its expected life. The plan of high rise structures is administered by lateral loads predominantly because of the earthquake. The inside basic framework or outside auxiliary framework gives the protection from lateral loads in the structure. The examination and outline of high rise structure with Single Moment Resisting Frame (SMRF) for 14 storey building with up to a 45m height. In this work, he defined first the reinforcement details by using manual design under IS-Codes and then it was analyzed in ETABs 2017 Version for the most important like Storey Drift and Location of the Shear Wall and investigated these results for 3 main types of the shear wall with Rectangular, Core Type and the Column Supported Shear Wall.

Priyanka Kosare [July 2019] showed that the primary purpose of all kinds of structural systems used in the building is to support gravity loads. The most common loads resulting from the effect of gravity are dead load, live load and snow load. Buildings are also subjected to lateral loads caused by wind, blasting or earthquake. The author evaluated the response of shear walls placed in the buildings subjected to seismic loads and studied the best possible location for positioning of shear wall to resist the seismic load efficiently. Shear wall is a structural member designed to counteract the lateral forces acting on a structure. These walls are more important in seismically active zones when shear forces on the structure increases due to earthquakes. Shear walls have more strength, stiffness and resist in-plane loads that are applied along its height. Buildings with shear walls which are properly designed and detailed have shown very good performance in past earthquakes. Various research studies have been conducted on the design of shear wall and its performance to seismic forces. This study compiled the evaluation of seismic performance of shear wall.

2.3 Summary of Literature Review

The researchers have been analyzed various structures with different shear wall locations. But study of dynamic analysis of building frames structure with shear wall at different position untouched. Considering this gap the problem is to study optimization of building frames with various plans with various positions of shear walls.

CHAPTER 3

METHODOLOGY

3.1 Introductions

Earthquake motion causes vibration of the structure leading to inertia forces. Thus a structure must be able to safely transmit the horizontal and the vertical inertia forces generated in the super structure through the foundation to the ground. Hence, for most of the ordinary structures, earthquake-resistant design requires ensuring that the structure has adequate lateral load carrying capacity. Seismic codes will guide a designer to safely design the structure for its intended purpose. Seismic codes are unique to a particular region or country. In India, IS 1893 is the main code that provides outline for calculating seismic design force. This force depends on the mass and seismic coefficient of the structure and the latter in turn depends on properties like seismic zone in which it rests and its ductility. Part of IS1893:2016 deals with assessment of seismic loads on various structures and building. Whole the code centers on the calculation of base shear and its distribution over height. Depending on the height of the structure and zone to which it belongs, type of analysis i.e. static analysis or dynamic analysis is performed.

3.2 Response Spectrum Method

This method is applicable for those structures where modes other than the fundamental one affect significantly the response of the structure. In this method the response of multi degree of freedom system is expressed as the superposition of modal response, each modal response being determined from the spectral analysis of single degree of freedom system, which is then combined to compare the total response. Modal analysis of the response history of structure to specified ground motion; however, the method is usually used in conjunction with a response spectrum.

3.3 Shear Wall Details

These are portions along the ends of a structural wall that are strengthened by longitudinal and transverse reinforcement. They may have the same thickness as that of the wall web.

Shear Wall (Structural Wall)

It is a vertically oriented planar element that is primarily designed to resist lateral force effects (axial force, shear force and bending moment) in its own plane.

Special Shear Wall

It is a structural wall meeting special detailing requirements for ductile behavior.

The Minimum Dimension of a Column

Shall not be less than, 20 d_b, Where, d_b is diameter of the largest diameter longitudinal reinforcement bar in the beam passing through or anchoring into the column at the joint or 300 mm as shown in fig. 3.1 below.

The cross-section aspect ratio (that is, ratio of smaller dimension to larger dimension of the cross-section of a column or inclined member) shall not be less than 0.45. Vertical members of RC buildings whose cross-section aspect ratio is less than 0.4 shall be designed as per requirement.

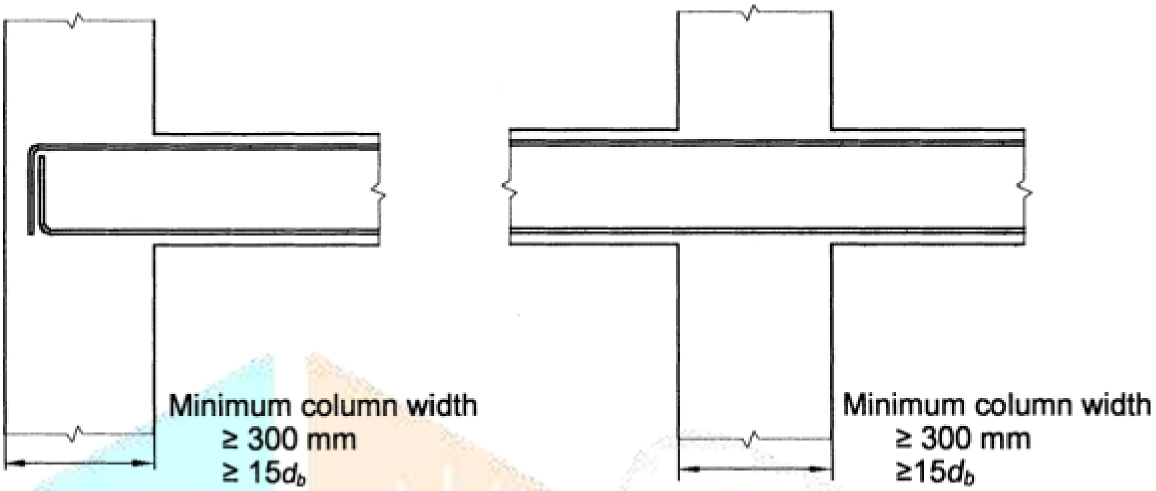


Fig 3.1: **Minimum size of RC columns based on diameter of largest longitudinal reinforcement bar in beams framing into it.**

3.4 Seismic Base Shear

According to IS 1893 (Part-I): 2002, Clause 7.5.3 the total design lateral force or design seismic base shear (Vb) along any principal direction is determined by

V_b = Ah.* W

Ah is the design horizontal acceleration spectrum

W is the seismic weight of building

3.5 Design Horizontal Acceleration Spectrum Value

For the purpose of determining the design seismic forces, the country (India) is classified into four seismic zones (II, III, IV and V). Previously, there were five zones, of which Zone I and II Are merged into Zone II in fifth revision of code. According to IS 1893: 2016 (Part 1), Clause6.4.2 Design Horizontal Seismic Forces coefficient Ah for a structure shall be determined by following expression

Ah = (Z/2)*(I/R)*(Sa /2g)

Where,

Z = Zone Factor Seismic Intensity

I= Importance Factor

R= Response Reduction Factor

Table 3.1 Seismic Zones of India Showing Tentative Percentage of Land Area

Seismic Intensity	**Low**	**Moderate**	**Severe**	**Very Severe**
Zone	II	III	IV	V
Z	0.10	0.16	0.24	0.36

India has been divided into four seismic zones. Zone II and Zone III are major zones covering more percentage of land area in India. Eastern India has higher seismic intensity. It fails under zone V. North-East India falls under zone IV. Geographical statistics of India shows that almost 54 % of the land is vulnerable to earthquakes. Table 3.1 & Fig.3.2 shows various seismic zones of India with tentative percentage of land area.

I = Importance factor is used to obtain the design seismic force depending on the functional use of the structure, characterized by hazardous consequences of its failure, its post earthquake functional need, historic value or economic importance (IS 1893-2016 Cl.no.6.4.2/table6/pg.no.18)

R = Response reduction factor depending on the perceived seismic damage performance of the structure characterized by ductile or brittle deformations which is shown in Table 3.2 (IS 1893-2016 cl.no.6.4.2/Table7/pg.no.23).

Sa/g = Average response acceleration coefficient (dimensionless value). The value of Sa/g is obtained from fig.3.3 from IS: 1893 (Part 1): 2016.

Table 3.2 Response Reduction Factor R for Building Systems

Sr. No.	Lateral Load Resisting System	R
1	Ordinary RC Moment Resisting Frame (OMRF)	3.0
2	Special RC Moment Resisting Frame (SMRF)	5.0
3	Ductile Shear Wall With SMRF	5.0

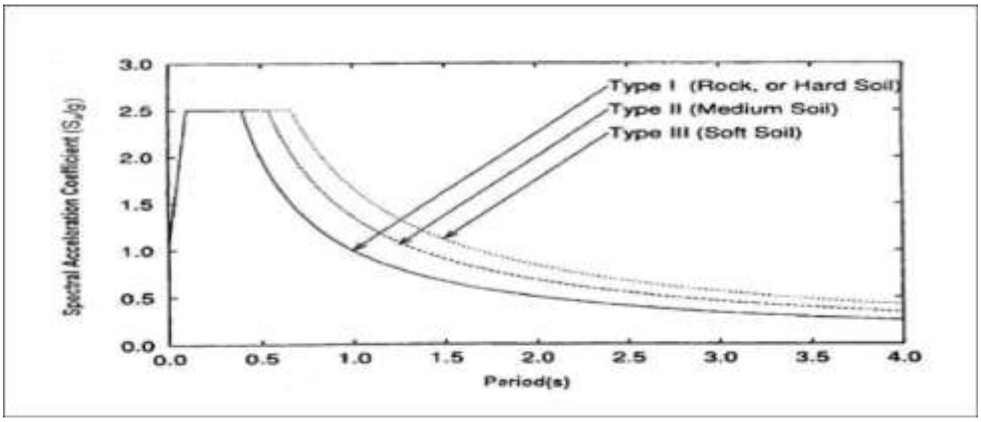


Fig. 3.2 Soil Graph Soft Medium and

3.6 For Soil Type and Time Period Graph

For rocky or hard soil sites:

1+15T	T< 0.10 s
2.5	0.1 s < T < 0.40 s
1/ T	0.4 s < T < 4.00 s
0.25	T > 4.00 s

For medium soil sites:

1+15T	T < 0.10 s
2.5	0.1 s < T < 0.55 s
1.36/ T	0.55 s < T < 4.00 s
0.34	T > 4.00 s

For soft soil sites:

1+15T	T < 0.10 s
2.5	0.1 s < T < 0.67 s

1.67/ T	0.67 s < T < 4.00 s
0.42	T > 4.00 s

3.7 Fundamental Natural Period

The fundamental natural time period as mentioned in clause 7.6 IS 1893 (part 1): 2016 for moment resisting RC frame building without brick infill walls and moment resisting steel frame building without brick infill walls, respectively is given by,

$$Ta = 0.075h^{0.7}$$

$$Ta = 0.085h^{0.75}$$

Where,

h = height of the building in m excluding basement storey, if it is connected with the ground floor decks or fitted in between the building column.

If there is brick filling, then the fundamental natural period of vibration, may be taken as $Ta = 0.09\, h/\sqrt{d}$

Where,

h = height of the building in m as defined above and

d = base dimension of the building at the plinth level, in meter, along the considered direction of the lateral force.

3.8 Seismic Weight

The seismic weight of the whole building is the sum of the seismic weights of all the floors. The seismic weight of each floor is its full dead load plus the appropriate amount of imposed load, the latter being that part of the imposed loads that may reasonably be expected to be attached to the structure at the time of earthquake shaking. It includes the weight of permanent and movable partitions, permanent equipment, a part of the live load, etc. While computing the seismic weight of each floor, the weight of columns and walls in any storey should be equally distributed to the floors above and below the storey. Any weight supported in between storey's should be distributed to the floors above and below in inverse proportion to its distance from the floors.

As per IS 1893(Part I):2016, the percentage of imposed load as given in Table 5 should be used. For calculating the design seismic forces of the structure, the imposed load on the roof need not be considered.

3.9 Distribution of Design Force

Table 3.4: For Percentage of Imposed Load to be considered

Imposed uniformly distributed floor load (KN/m^2)	**Percentage of Imposed load**
Up to and including 3.0	25
Above 3.0	50

Buildings and their elements should be designed and constructed to resist the effects of design lateral force. The design lateral force is first computed for the building as a whole and then distributed to various floor levels. The overall design seismic force thus obtained at each floor level is then distributed to individual lateral load-resisting elements, depending on the floor diaphragm action.

As per IS1893-1:2002 Clause 7.7, the design base shear (Vb) is distributed along the height of the building as per the following expression.

$$Qi = \mathrm{Vb}\, \frac{Wi\, hi}{\sum Wi\, hi\text{\^{}}2}$$

Where,

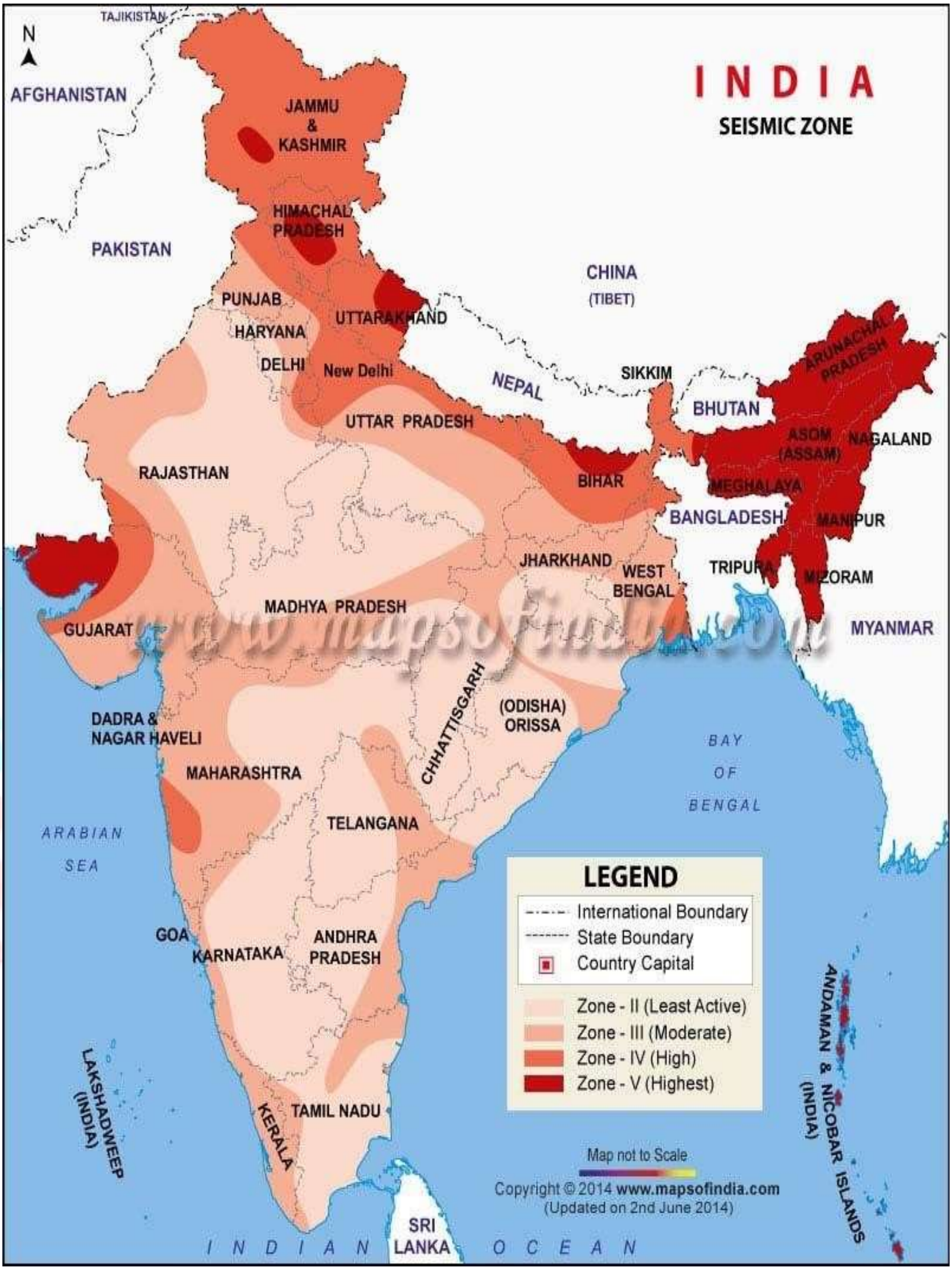
Qi = design lateral force at i^{th} floor

Wi= seismic weight of i^{th} floor

hi = height of i^{th} floor measured from base, and

n = numbers of storey in the building is the number of the levels at which the masses are located.

3.10 Zone Map of India



CHAPTER 4

THEORETICAL FORMATIONS

4.1 Introduction

In this title of parametric investigation, a detailed study and design of high rise framed structure using shear wall, IS codes has been presented. Study has been done on reinforced concrete structure. Analysis of all the above mentioned structures has been carried out by using Indian Standard with Response spectrum Method. Cost effectiveness of structures has also been studied only from material point of view.

4.2 Problem Formulation

G+15 multi-storied reinforced concrete building, moment resisting space frame have been analyzed using professional software. Model (G+15) of building frame with regular shear wall and percentage of shear wall is analyzed by response spectrum method. The plan dimensions of buildings are shown in table below. The plan view of building, elevation of different frames is shown in figures below.

Table 4.1 Detail Features of Building

Sr. No.	Parameters	Values
1	Material used	Concrete-M25 and M30 Reinforcement Fe415 & Fe500 MPa
2	Plan dimension	1.Square Building Plan 24m X 24m 2.Rectangular Building Plan 20m X 28m
3	Height of each Storey	3.0m
4	Height of ground Storey	2.0m
5	Density of concrete	$25kN/m^3$
6	Poisson ratio	0.2-concrete and 0.15-steel
7	Density of brick	$20kN/m^3$
9	Code of Practice adopted	IS456:2000, IS1893:2016
10	Seismic zone as per IS1893:2002	III
12	Importance factor	1
13	Response reduction factor	5
14	Foundation soil	Medium
15	Slab thickness	150mm
16	Wall thickness	150mm
17	Floor Finish	$1kN/m^2$
18	Live load	$3 kN/m^2$
19	Earthquake load	As per IS 1893:2016
20	Wind load	As per IS 875: 2015
21	Size of beam	450x230, 580x300 and 600X230 mm

22	Column size	530x300 and 600X300, 680X300 mm
23	Shear wall size	230mm
24	Model to be designed	G+15
25	Ductility class	IS1893:2016 SMRF
27	Basic wind speed (Vb)	39 m/sec
28	Terrain category	2
29	Risk coefficient	1
30	Topography factor	1

4.3 Load Case and Load Combination:

Unless otherwise specified, all loads listed shall be considered in design for the Indian Code following load combinations shall be considered:

Load cases:

1) DL: Dead load
2) LL: Live load
3) EQ: Earthquake load
4) W: Wind Load

Load Combinations:

1) 1.5DL+1.5LL
2) 1.2DL+1.2LL + 1.2EX
3) 1.2DL+1.2LL- 1.2EX
4) 1.2DL+1.2LL+ 1.2EY
5) 1.2DL+1.2LL - 1.2EY
6) 1.2DL+1.2LL+1.2WLX

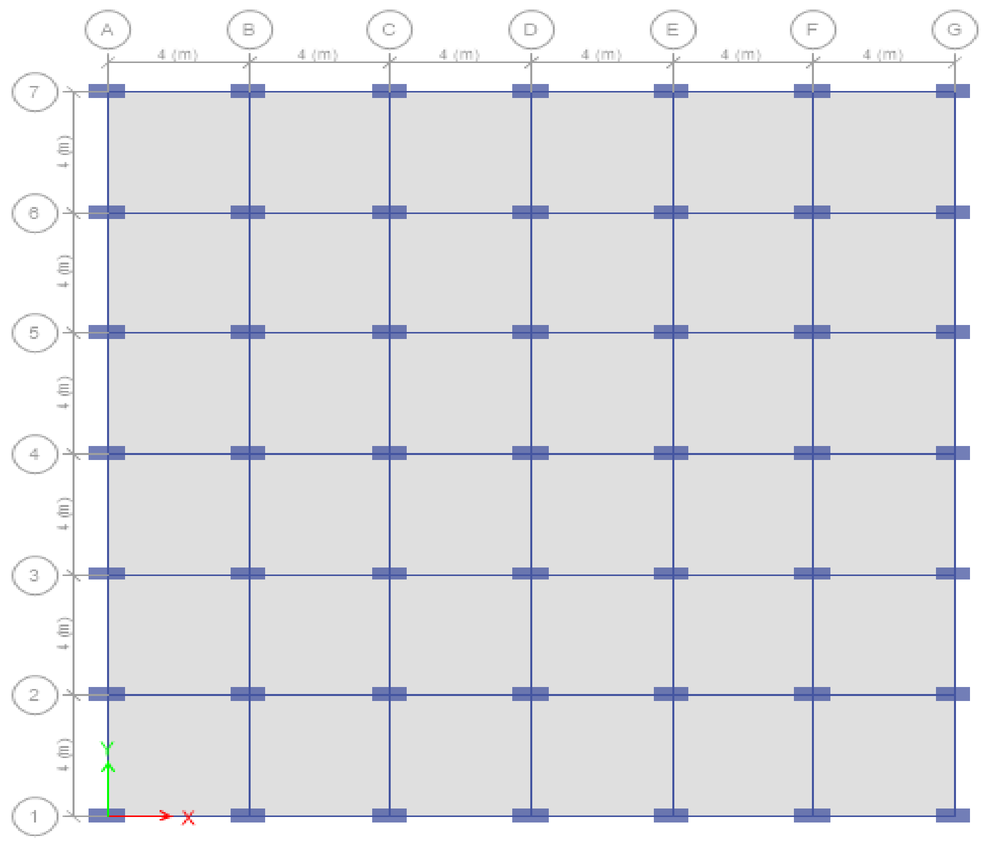
7) 1.2DL+1.2LL-1.2WLX

8) 1.2DL+1.2LL+1.2WLY

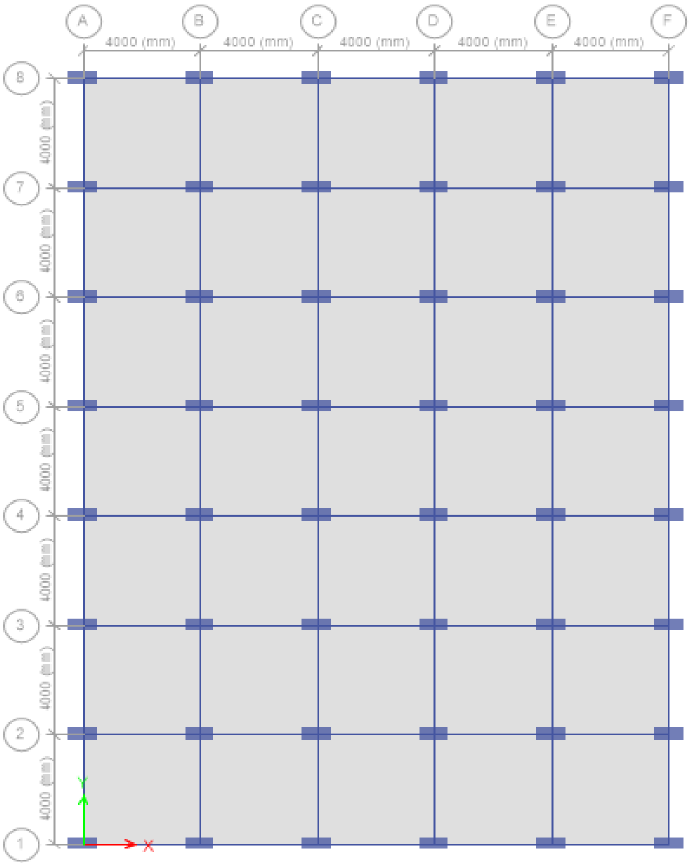
9) 1.2DL+1.2LL-1.2WL

4.4 Software Plan and Model Screenshots

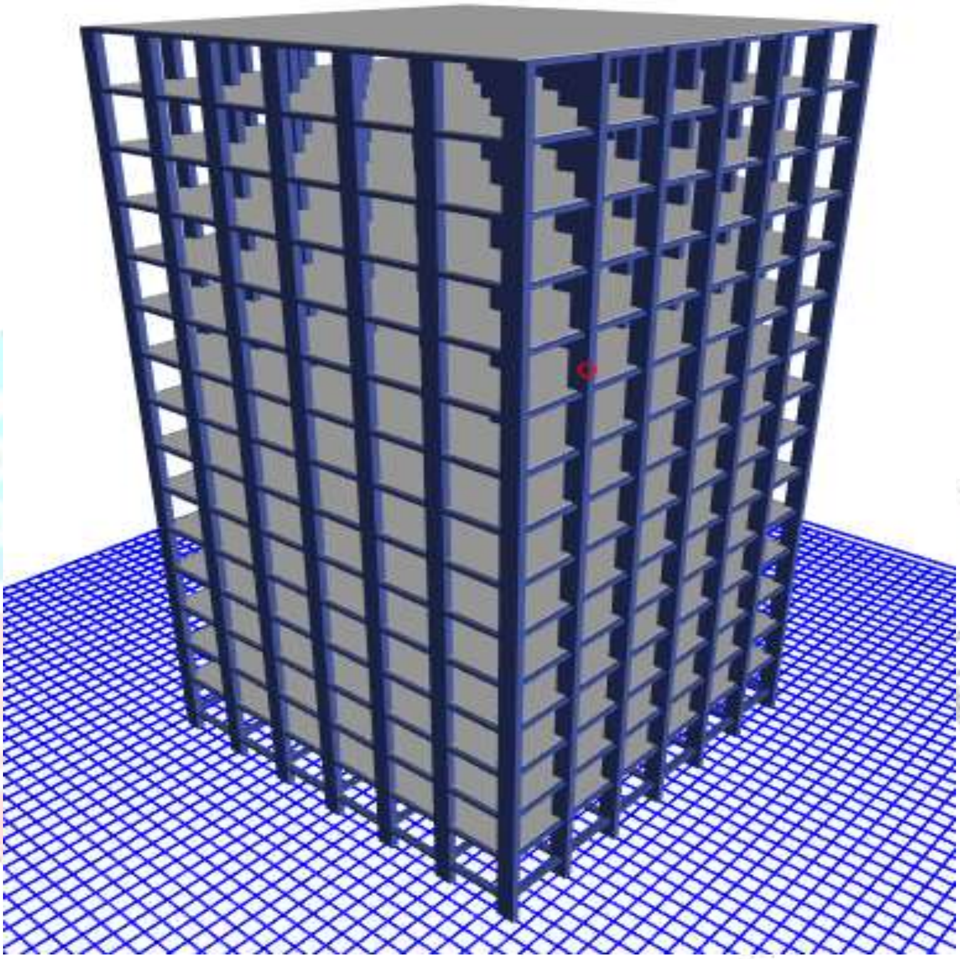
A. Software Plan Square Shape



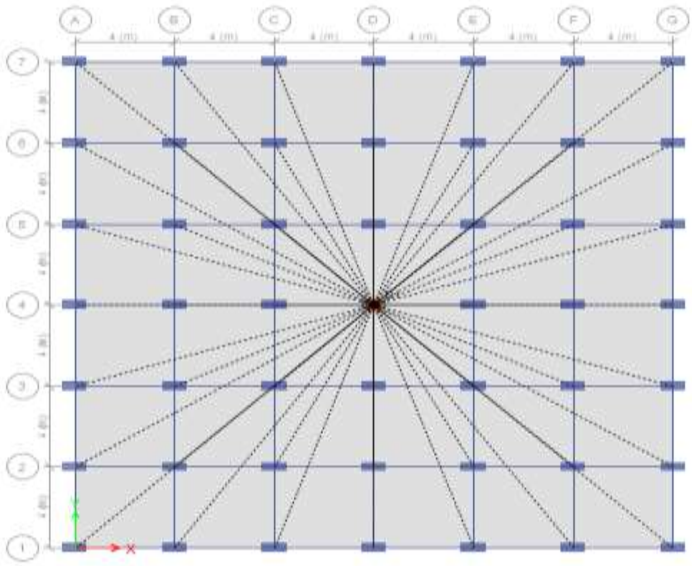
B. Software Plan Rectangular Shape



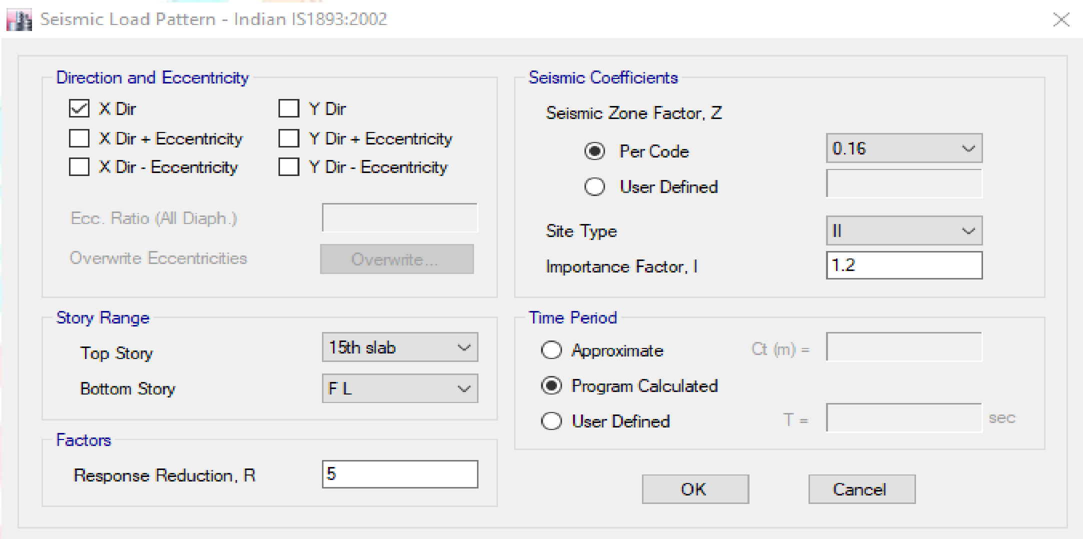
C. G+15 Storey Without Shear Wall Software Model



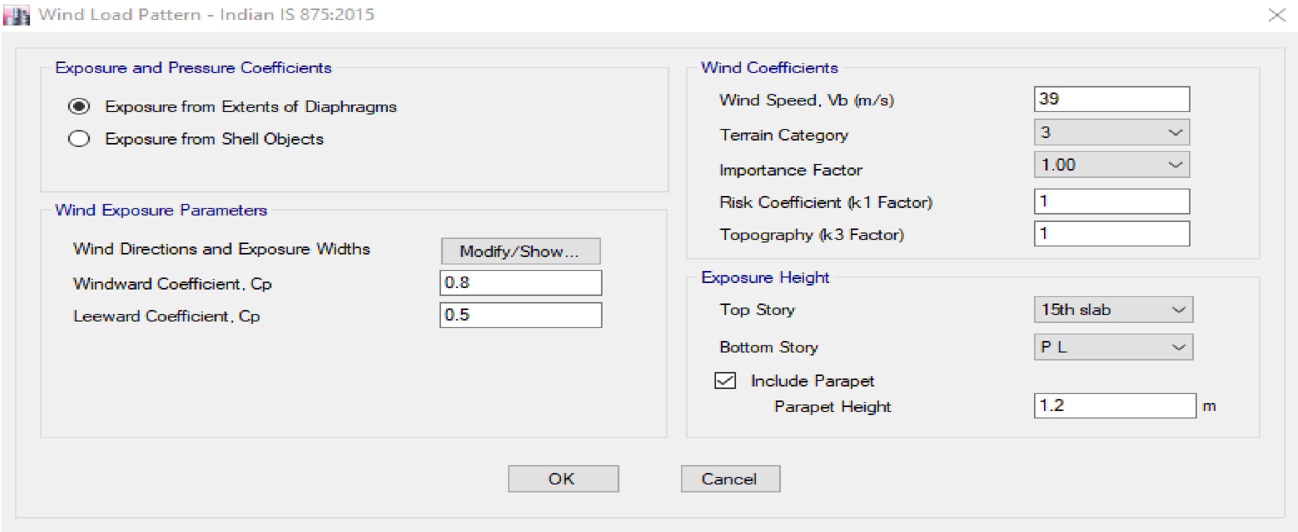
D. Diaphragms Assign



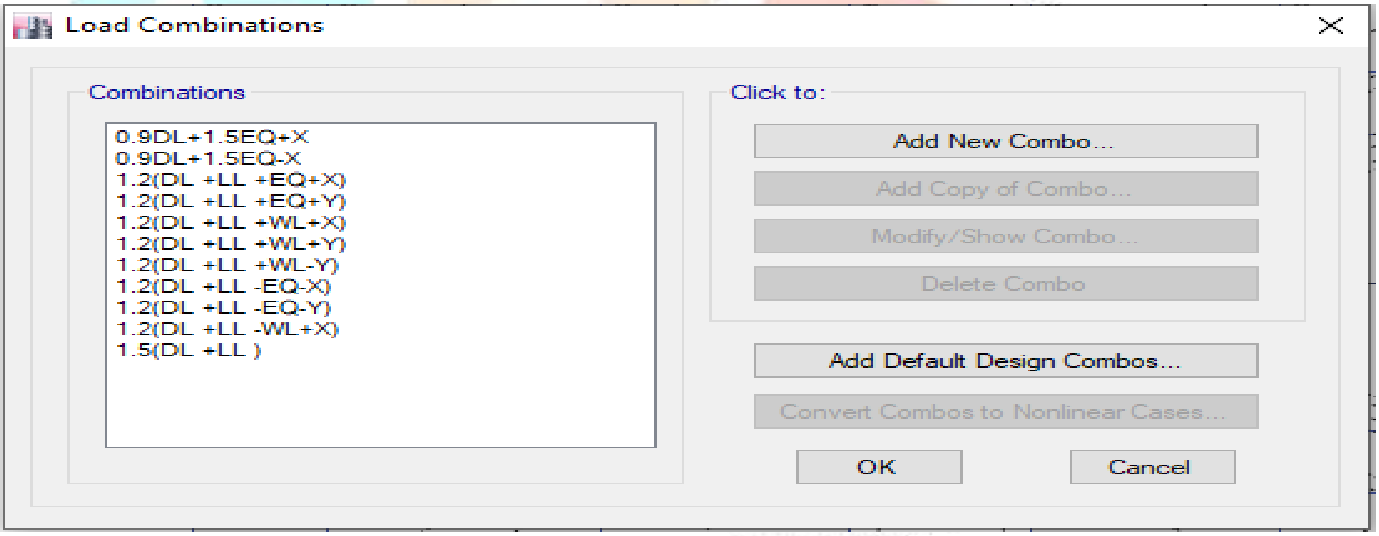
E. Earthquake Load Define



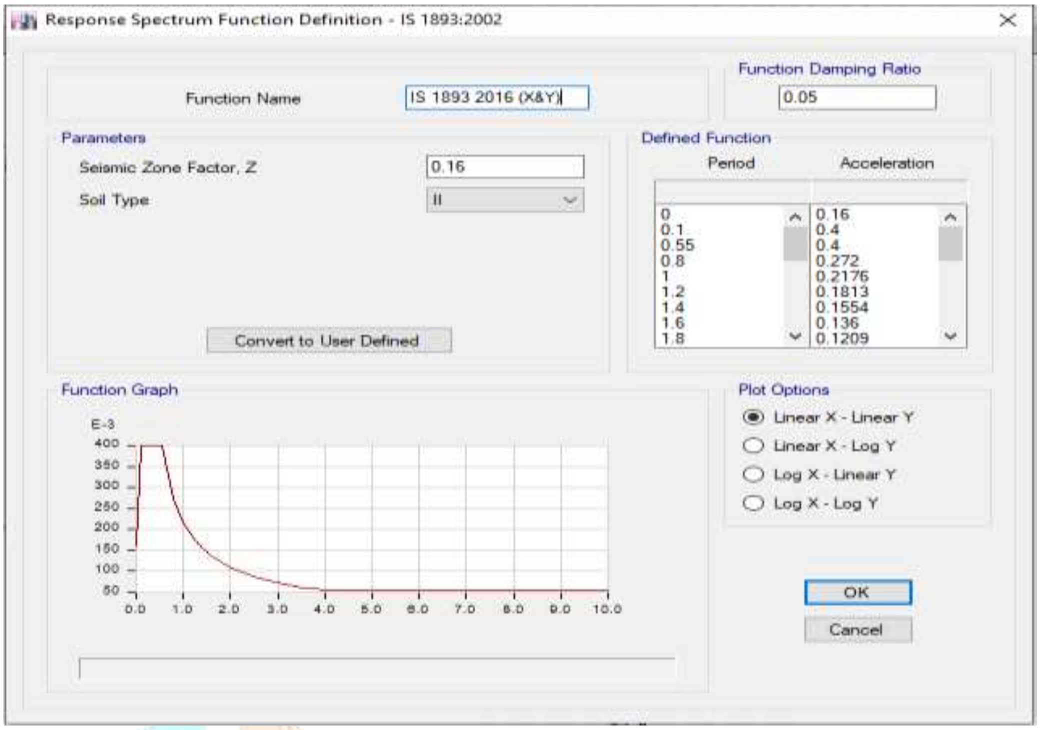
F. Wind Load Define



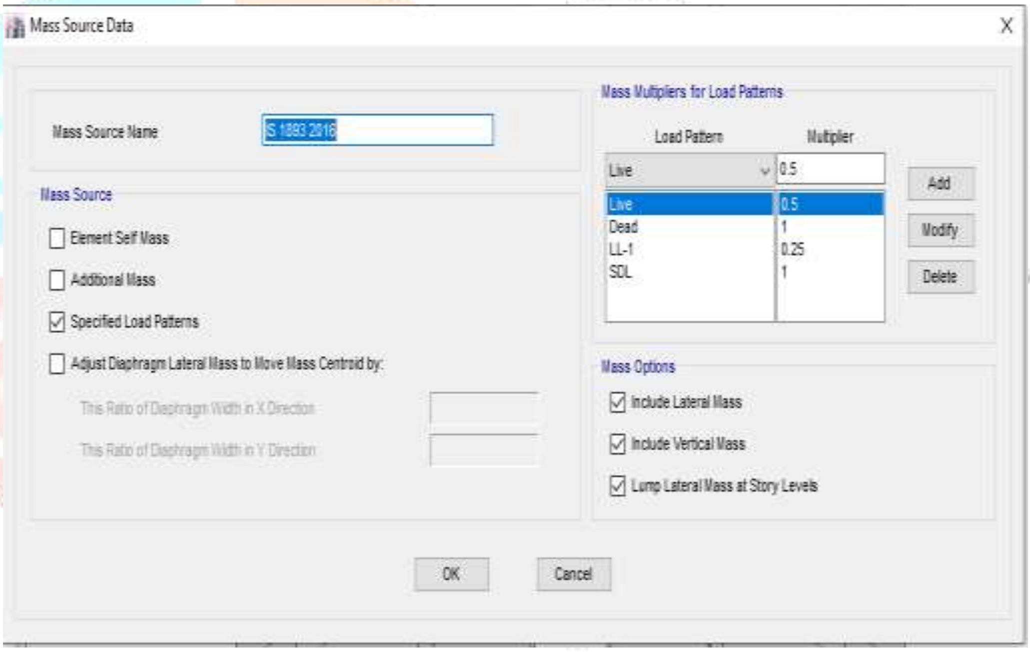
G. Load Combinations Define



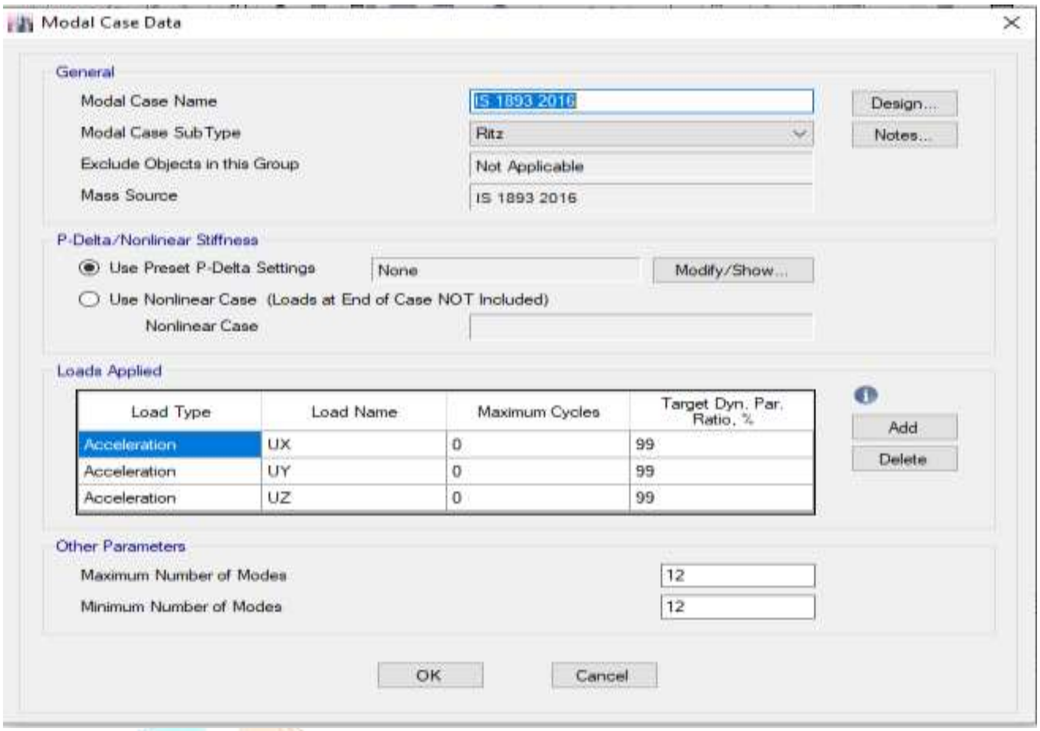
H. Mass Source Define



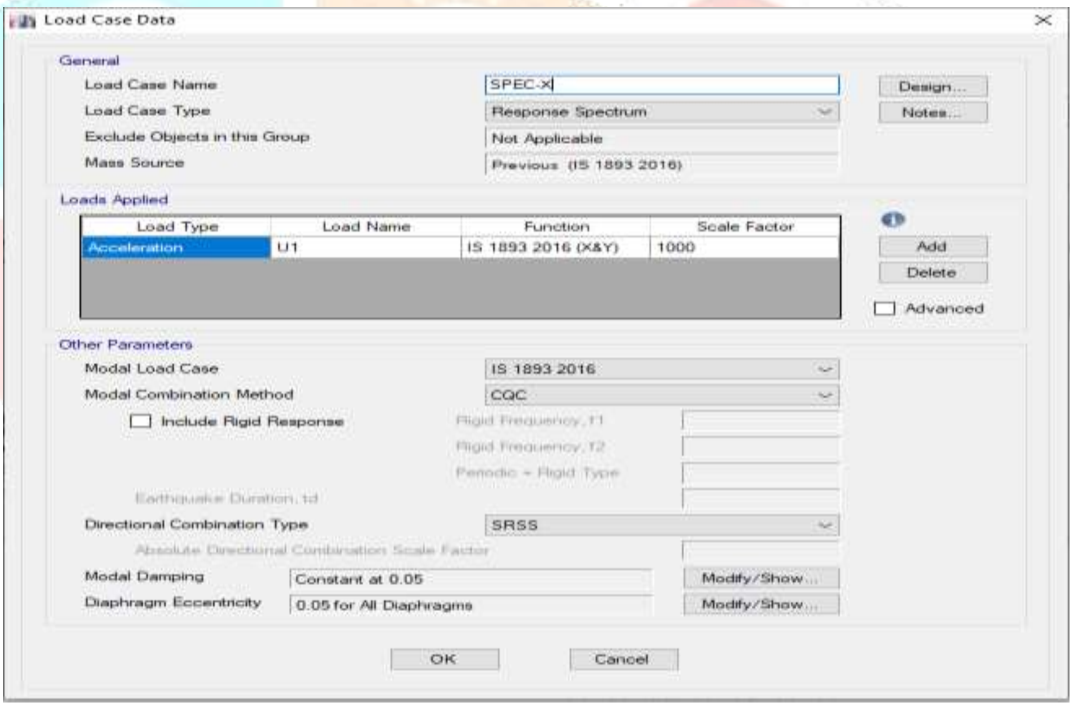
I. Response Spectrum Case Define



J. Modal Case Define



K. Response Spectrum Functions Define



CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Base Shear Results for Square Shape Building

Table 5.1.1 Base Shear Results for G+15 Storey, Corner Locations Shear Wall Building and Periphery Location Shear Wall Building

Load Pattern	Z	Soil Type	R	Base Shear (kN)	Base Shear (kN)

				Corner	periphery
EQ+X	0.16	II	5	1616.9633	2141.5694
EQ-X	0.16	II	5	1616.9633	2141.5694
EQ+Y	0.16	II	5	1306.5578	1763.9087
EQ-Y	0.16	II	5	1306.5578	1763.9087

Graph 5.1.1 Base Shear Results for Corner and periphery locations of Shear Wall

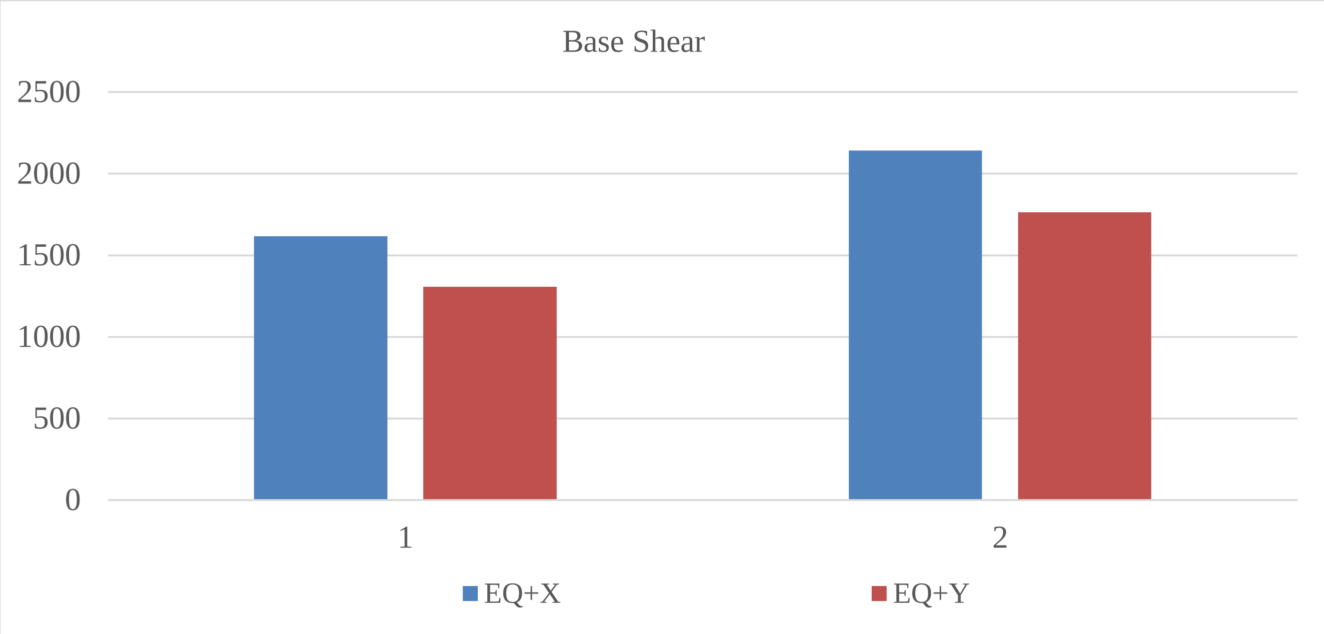


Table 5.1.2 Earthquake Displacement Results For G+15 Storey, Corner and Periphery locations of shear wall

Diaphragm Centre of Mass Displacements							
Storey	**Load Case/Combo**	**UX (mm)**	**UX (mm)**	**Point**	**X**	**Y**	**Z**
		Corner	**periphery**		mm	mm	mm
15th slab	EQ+X	28.462	21.528	894	12000	12000	46500
14th slab	EQ+X	26.484	19.896	895	12000	12000	43500
13th slab	EQ+X	24.436	18.23	896	12000	12000	40500
12th slab	EQ+X	22.317	16.53	897	12000	12000	37500
11th slab	EQ+X	20.129	14.802	898	12000	12000	34500

10th slab	EQ+X	17.884	13.055	899	12000	12000	31500
9th slab	EQ+X	15.602	11.307	900	12000	12000	28500
8th slab	EQ+X	13.311	9.578	901	12000	12000	25500
7th slab	EQ+X	11.048	7.892	902	12000	12000	22500
6th slab	EQ+X	8.852	6.279	903	12000	12000	19500
5th slab	EQ+X	6.771	4.77	904	12000	12000	16500
4th slab	EQ+X	4.855	3.398	905	12000	12000	13500
3rd slab	EQ+X	3.162	2.2	906	12000	12000	10500
2nd slab	EQ+X	1.756	1.218	907	12000	12000	7500
1st slab	EQ+X	0.706	0.492	908	12000	12000	4500

Graph 5.1.2 Earthquake Displacement vs. Corner and Periphery Locations of Shear Wall

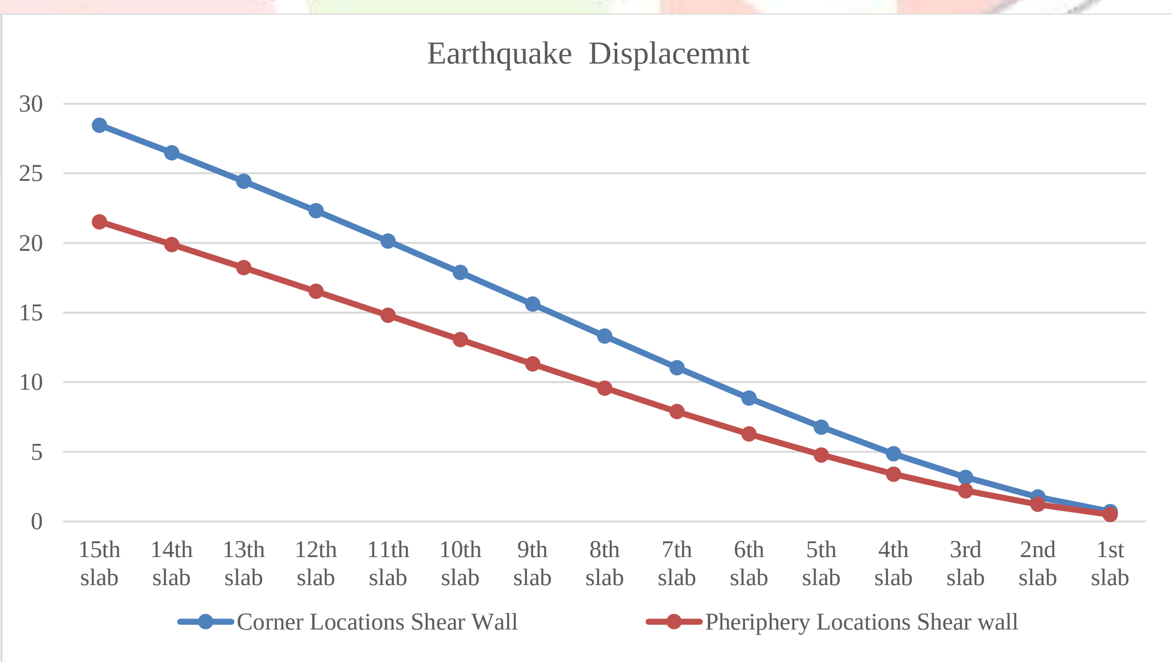


Table 5.1.3 Wind Displacement Results for G+15 Storey, Corner and Periphery locations of Shear Wall Building

Diaphragm Centre of Mass Displacements							
Storey	**Load Case/Combo**	**UX (mm)**	**UX (mm)**	**Point**	**X**	**Y**	**Z**

		Corner	**periphery**		mm	mm	mm
15th slab	WL+X	16.44	9.345	894	12000	12000	46500
14th slab	WL+X	15.371	8.672	895	12000	12000	43500
13th slab	WL+X	14.266	7.986	896	12000	12000	40500
12th slab	WL+X	13.122	7.287	897	12000	12000	37500
11th slab	WL+X	11.935	6.573	898	12000	12000	34500
10th slab	WL+X	10.707	5.846	899	12000	12000	31500
9th slab	WL+X	9.442	5.112	900	12000	12000	28500
8th slab	WL+X	8.153	4.377	901	12000	12000	25500
7th slab	WL+X	6.855	3.649	902	12000	12000	22500
6th slab	WL+X	5.569	2.94	903	12000	12000	19500
5th slab	WL+X	4.323	2.264	904	12000	12000	16500
4th slab	WL+X	3.15	1.637	905	12000	12000	13500
3rd slab	WL+X	2.087	1.078	906	12000	12000	10500
2nd slab	WL+X	1.182	0.609	907	12000	12000	7500
1st slab	WL+X	0.486	0.253	908	12000	12000	4500

Graph 5.1.3 Wind Displacement for Corner and Periphery locations of Shear Wall Building

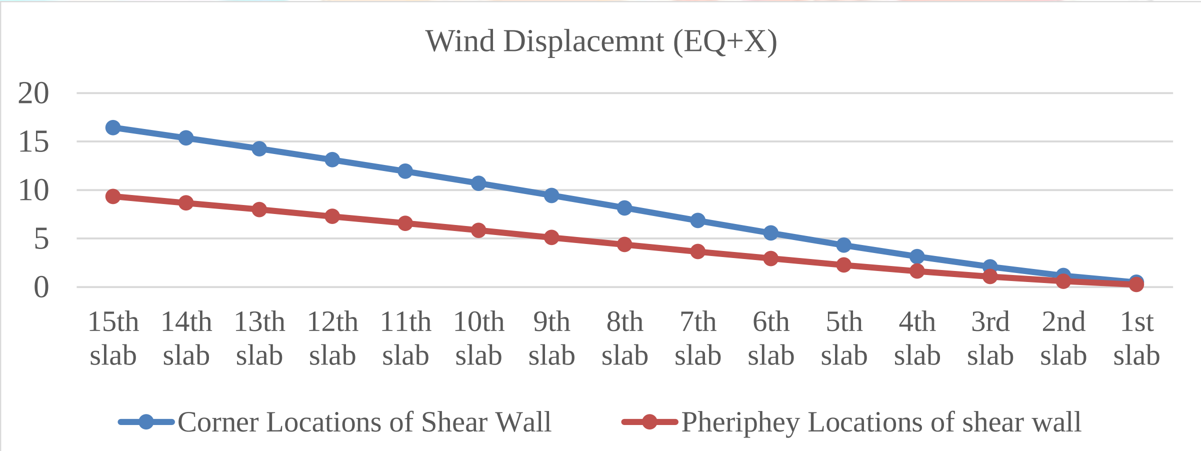


Table 5.1.4 Storey Drift Results for G+15 Storey, Without Shear Wall Building

TABLE: Storey Drifts							
Storey	**Load Case/Combo**	**Drift**	**Drift**	**Label**	**X**	**Y**	**Z**
		Corner	**periphery**		mm	mm	mm
15th slab	EQ+X	0.00066	0.000544	43	24000	0	46500
14th slab	EQ+X	0.000683	0.000556	43	24000	0	43500
13th slab	EQ+X	0.000706	0.000567	43	24000	0	40500
12th slab	EQ+X	0.000729	0.000576	43	24000	0	37500
11th slab	EQ+X	0.000748	0.000582	43	24000	0	34500

10th slab	EQ+X	0.000761	0.000583	43	24000	0	31500
9th slab	EQ+X	0.000763	0.000576	43	24000	0	28500
8th slab	EQ+X	0.000755	0.000562	43	24000	0	25500
7th slab	EQ+X	0.000732	0.000538	43	24000	0	22500
6th slab	EQ+X	0.000694	0.000503	43	24000	0	19500
5th slab	EQ+X	0.000639	0.000457	43	24000	0	16500
4th slab	EQ+X	0.000564	0.000399	43	24000	0	13500
3rd slab	EQ+X	0.000469	0.000328	43	24000	0	10500
2nd slab	EQ+X	0.00035	0.000242	43	24000	0	7500
1st slab	EQ+X	0.000208	0.00015	1	0	0	4500
P L	EQ+X	0.000084	0.000075	8	4000	0	1500

Graph 5.1.4 Storey Drift vs. Corner and Periphery Locations of Shear Wall

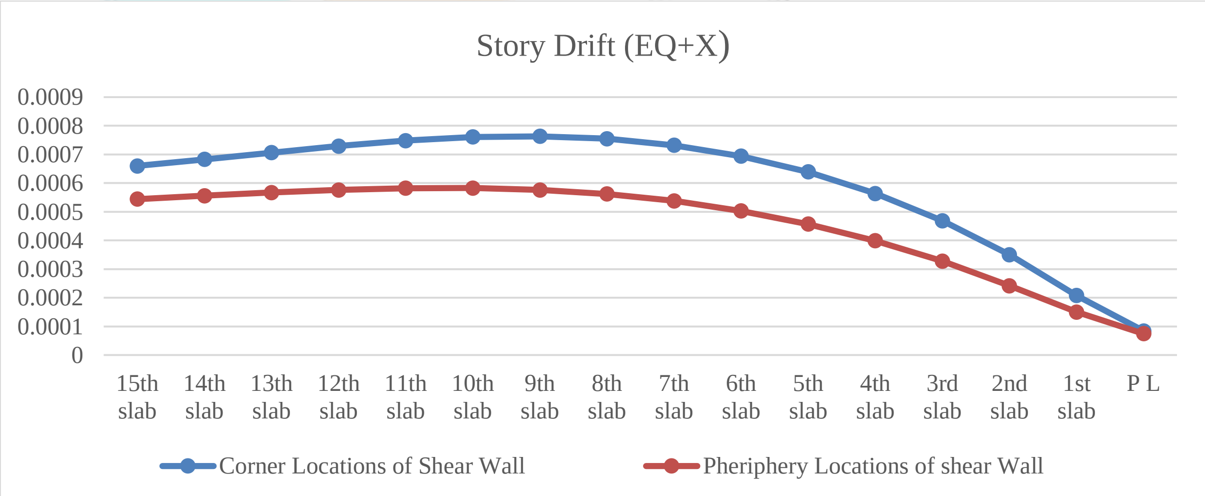


Table 5.1.5 Base Shear Results for G+15 Storey Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

TABLE: Auto Seismic - IS 1893:2002						
Load Pattern	**Z**	**Soil Type**	**R**	**Base Shear** (kN)	**Base Shear** (kN)	**Base Shear** (kN)
				Longer Span	**Mid Span**	**Shorter span**
EQ+X	0.16	II	5	1843.2726	2581.307	1011.512
EQ-X	0.16	II	5	1843.2726	2581.307	1011.512
EQ+Y	0.16	II	5	789.9991	2133.1201	1467.8379
EQ-Y	0.16	II	5	789.9991	2133.1201	1467.8379

Graph 5.1.5 Base Shear Results vs.for Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

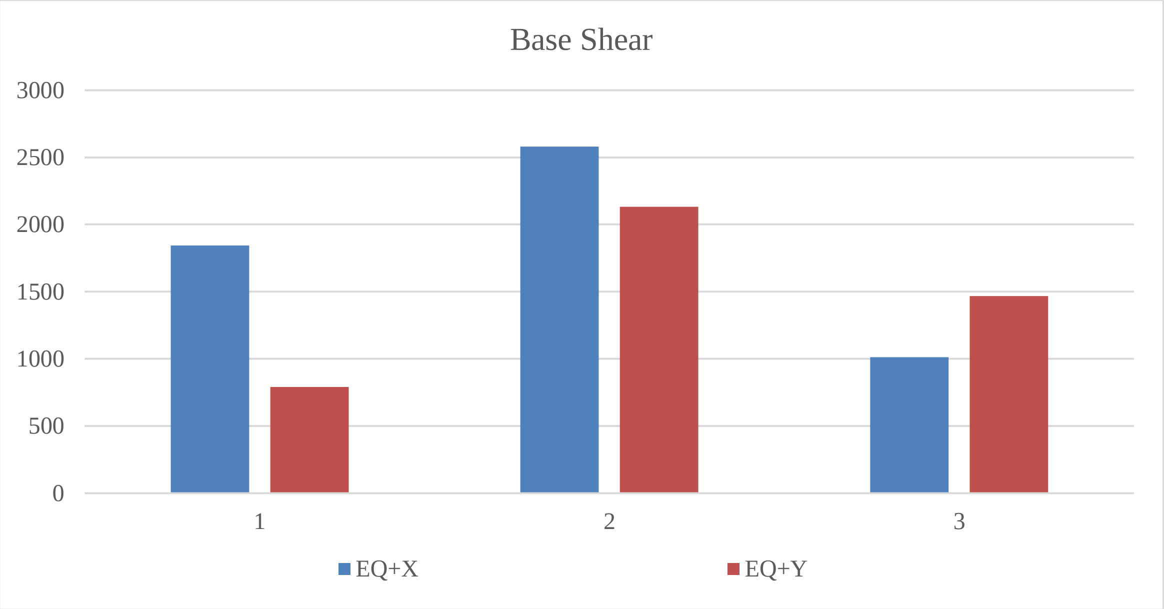


Table 5.1.6 Earthquake Displacement Results Ffor G+15 Storey, Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

Diaphragm Centre of Mass Displacements								
Storey	**Load Case/Combo**	**UX(mm)**	**UX(mm)**	**UX(mm)**	**Point**	**X**	**Y**	**Z**
		Longer Span	**Mid Span**	**Shorter span**		mm	mm	mm
15th slab	EQ+X	23.421	15.572	34.363	666	12000	12000	46500
14th slab	EQ+X	21.84	14.387	33.309	738	12000	12000	43500
13th slab	EQ+X	20.206	13.17	32.025	792	12000	12000	40500
12th slab	EQ+X	18.507	11.928	30.443	864	12000	12000	37500
11th slab	EQ+X	16.74	10.669	28.549	894	12000	12000	34500
10th slab	EQ+X	14.912	9.403	26.357	895	12000	12000	31500
9th slab	EQ+X	13.04	8.143	23.901	896	12000	12000	28500
8th slab	EQ+X	11.149	6.905	21.221	897	12000	12000	25500
7th slab	EQ+X	9.267	5.706	18.367	898	12000	12000	22500
6th slab	EQ+X	7.43	4.563	15.392	899	12000	12000	19500
5th slab	EQ+X	5.68	3.496	12.357	900	12000	12000	16500
4th slab	EQ+X	4.064	2.526	9.337	901	12000	12000	13500
3rd slab	EQ+X	2.632	1.673	6.43	902	12000	12000	10500

2nd slab	EQ+X	1.445	0.961	3.778	903	12000	12000	7500
1st slab	EQ+X	0.569	0.413	1.594	904	12000	12000	4500

Graph 5.1.6 Earthquake Displacement for Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

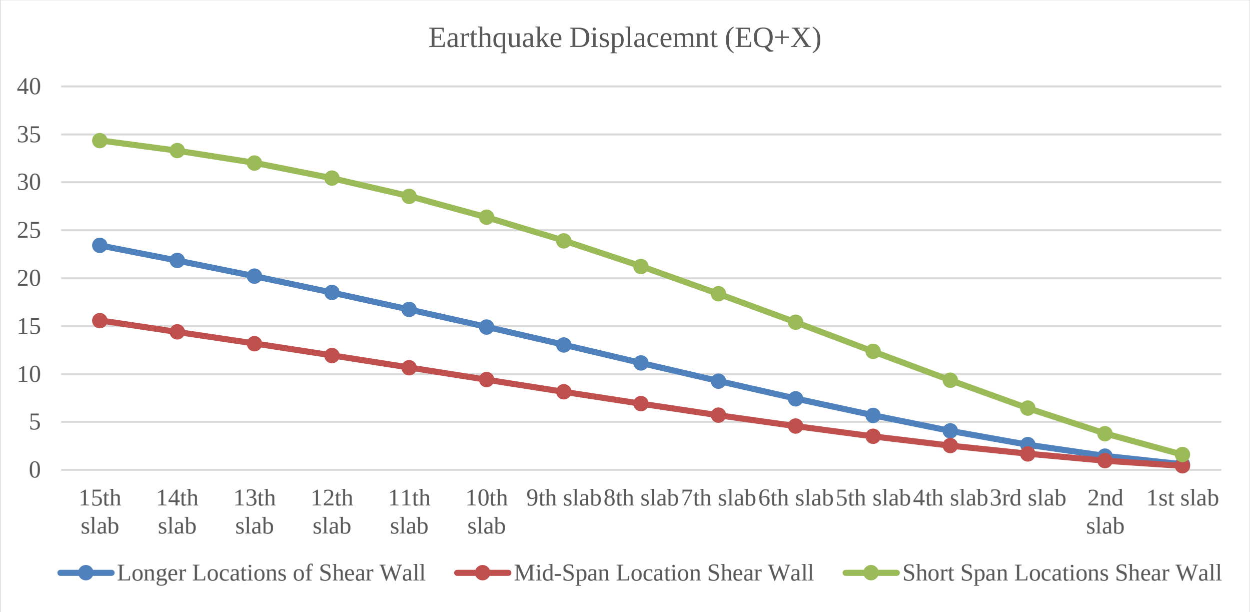


Table 5.1.7 Wind Displacement Results for G+15 Storey, Longer Span Locations, Mid Span and Shorter Span Location Shear Wall Building

Diaphragm Centre of Mass Displacements								
Storey	**Load Case/Combo**	**UX(mm)**	**UX(mm)**	**UX(mm)**	**Point**	**X**	**Y**	**Z**
		Longer Span	**Mid Span**	**Shorter span**		mm	mm	mm

15th slab	WL+X	11.85	5.57	32.84	666	12000	12000	46500
14th slab	WL+X	11.109	5.167	32.031	738	12000	12000	43500
13th slab	WL+X	10.344	4.756	31.051	792	12000	12000	40500
12th slab	WL+X	9.546	4.336	29.837	864	12000	12000	37500
11th slab	WL+X	8.711	3.91	28.354	894	12000	12000	34500
10th slab	WL+X	7.839	3.479	26.586	895	12000	12000	31500
9th slab	WL+X	6.932	3.046	24.531	896	12000	12000	28500
8th slab	WL+X	6	2.615	22.195	897	12000	12000	25500
7th slab	WL+X	5.053	2.191	19.596	898	12000	12000	22500
6th slab	WL+X	4.108	1.78	16.763	899	12000	12000	19500
5th slab	WL+X	3.187	1.387	13.741	900	12000	12000	16500
4th slab	WL+X	2.314	1.022	10.601	901	12000	12000	13500
3rd slab	WL+X	1.523	0.693	7.451	902	12000	12000	10500
2nd slab	WL+X	0.851	0.409	4.466	903	12000	12000	7500
1st slab	WL+X	0.341	0.183	1.919	904	12000	12000	4500

Graph 5.1.7 Wind Displacement vs. Longer Span Locations, Mid Span and Shorter Span Location Shear Wall Building

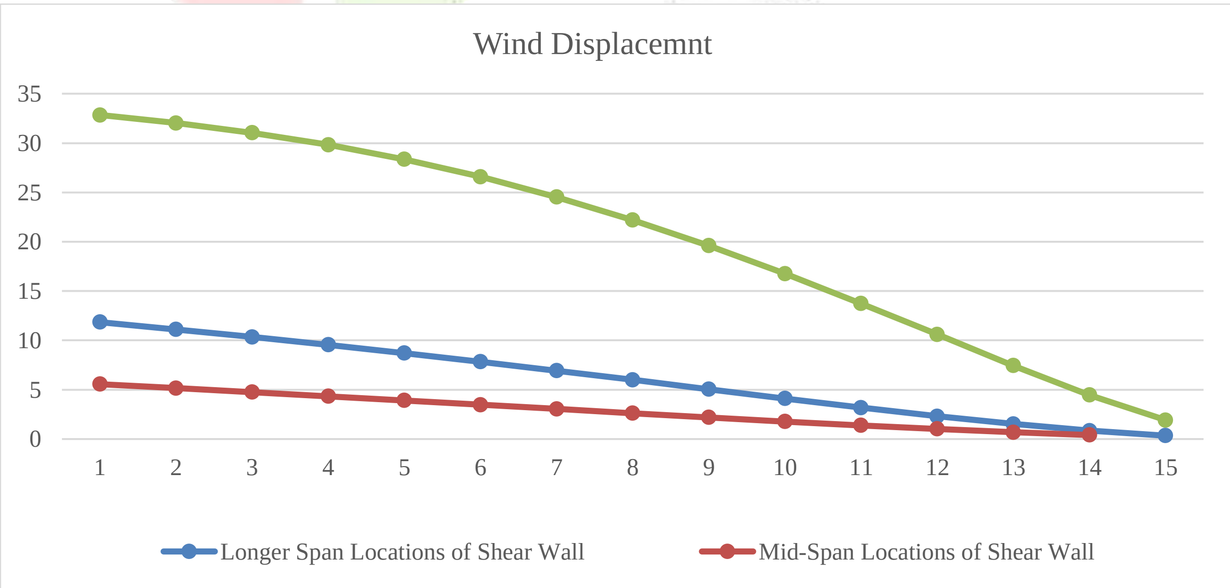


Table 5.1.8 Storey Drift Results for G+15 Storey, Longer Span Locations, Mid Span and Shorter Span Location Shear Wall Building

Storey Drifts								
Storey	**Load Case/Combo**	**Drift**	**Drift**	**Drift**	**Label**	**X**	**Y**	**Z**
		Longer Span	**Mid Span**	**Shorter span**		mm	mm	mm
15th slab	EQ+X	0.000527	0.000395	0.000351	43	24000	0	46500
14th slab	EQ+X	0.000545	0.000406	0.000428	43	24000	0	43500
13th slab	EQ+X	0.000566	0.000415	0.000527	43	24000	0	40500
12th slab	EQ+X	0.000589	0.000421	0.000631	43	24000	0	37500
11th slab	EQ+X	0.000609	0.000423	0.000731	43	24000	0	34500
10th slab	EQ+X	0.000624	0.000421	0.000819	43	24000	0	31500
9th slab	EQ+X	0.000631	0.000414	0.000893	43	24000	0	28500
8th slab	EQ+X	0.000627	0.000401	0.000951	43	24000	0	25500
7th slab	EQ+X	0.000612	0.000382	0.000992	43	24000	0	22500
6th slab	EQ+X	0.000583	0.000357	0.001012	43	24000	0	19500
5th slab	EQ+X	0.000539	0.000325	0.001007	43	24000	0	16500
4th slab	EQ+X	0.000477	0.000286	0.000969	43	24000	0	13500
3rd slab	EQ+X	0.000396	0.000239	0.000884	43	24000	0	10500
2nd slab	EQ+X	0.000292	0.000184	0.000728	43	24000	0	7500
1st slab	EQ+X	0.000166	0.00012	0.000461	46	24000	12000	4500
P L	EQ+X	0.000055	0.000069	0.000152	44	24000	4000	1500

Graph 5.1.8 Storey Drift for Corner and Periphery Locations of Shear Wall

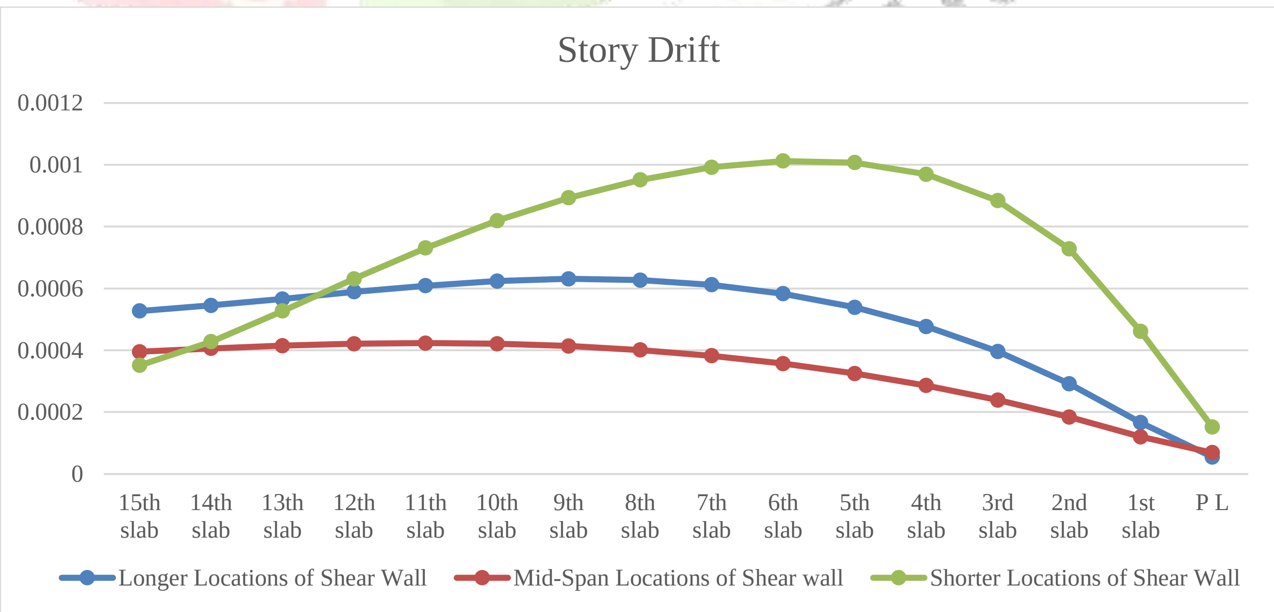


Table 5.1.9 Base Shear Results for G+15 Storey, Without Shear Wall Building, with shear Wall i.e. 10%, 15%, 20% and 25%

Base shear – Auto Siesmic - IS 1893:2002

Load Pattern	Z	Soil Type	I	R	Without shear wall	10% shear wall	15% Base Shear	20% Base Shear	25% Base Shear
					kN	kN	kN	kN	kN
EQ+X	0.16	II	1.2	5	1162.365	1432.972	1561.031	1688.897	1815.11
EQ-X	0.16	II	1.2	5	1162.365	1432.972	1561.031	1688.897	1815.11
EQ+Y	0.16	II	1.2	5	840.535	820.4684	812.5638	811.9287	796.4074
EQ-Y	0.16	II	1.2	5	840.535	820.4684	812.5638	811.9287	796.4074

Graph 5.1.9 Base Shear Results for Without Shear Wall Building, with shear Wall i.e. 10%, 15%, 20% and 25%

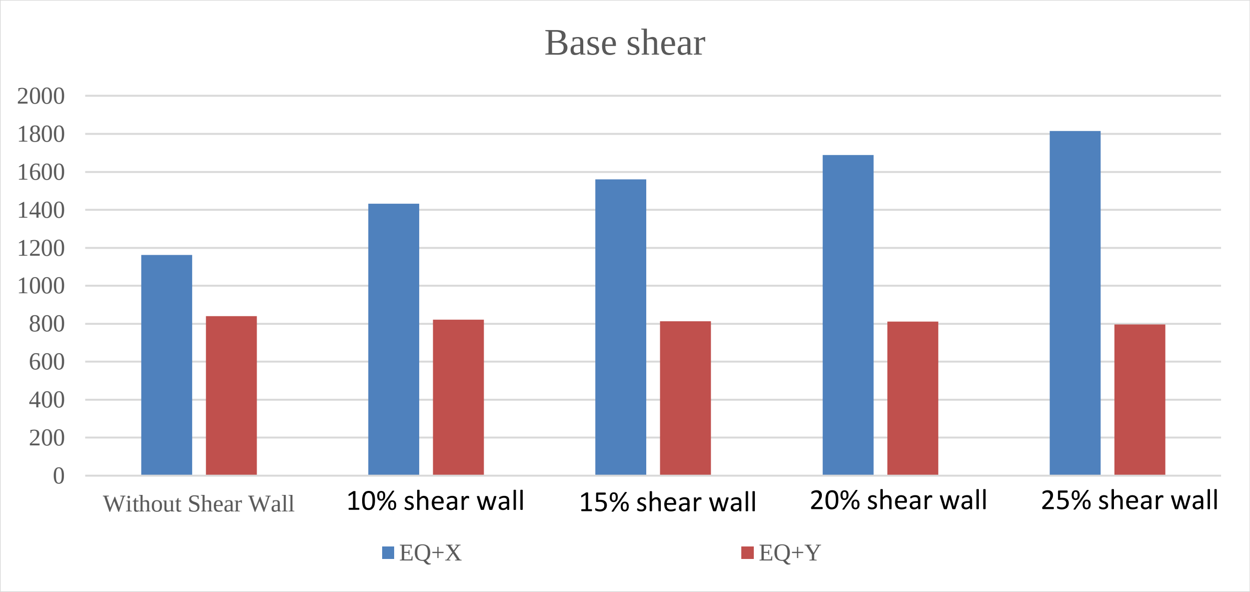


Table 5.1.10 Earthquake Displacement Results for G+15 Storey, Without Shear Wall Building, with shear Wall i.e. 10%, 15%, 20% and 25%

Diaphragm Centre of Mass Displacements							
Storey	Load Case/Combo	UX	UX	UX	UX	UX	Point
		Without shear wall	10% shear wall	15% Base Shear	20% Base Shear	25% Base Shear	
15th slab	EQ+X	35.425	30.168	27.814	26.171	24.342	894
14th slab	EQ+X	34.064	28.414	26.104	24.502	22.675	895
13th slab	EQ+X	32.505	26.56	24.311	22.762	20.955	896
12th slab	EQ+X	30.685	24.579	22.416	20.935	19.171	897
11th slab	EQ+X	28.585	22.46	20.411	19.014	17.32	898

10th slab	EQ+X	26.213	20.212	18.303	17.008	15.411	899
9th slab	EQ+X	23.596	17.854	16.111	14.934	13.461	900
8th slab	EQ+X	20.776	15.419	13.864	12.82	11.494	901
7th slab	EQ+X	17.805	12.948	11.6	10.7	9.542	902
6th slab	EQ+X	14.744	10.49	9.364	8.615	7.641	903
5th slab	EQ+X	11.667	8.106	7.209	6.614	5.833	904
4th slab	EQ+X	8.66	5.864	5.194	4.753	4.166	905
3rd slab	EQ+X	5.836	3.843	3.39	3.093	2.694	906
2nd slab	EQ+X	3.338	2.136	1.876	1.706	1.476	907
1st slab	EQ+X	1.361	0.85	0.744	0.675	0.579	908

Graph 5.1.10 Earthquake Displacement for Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

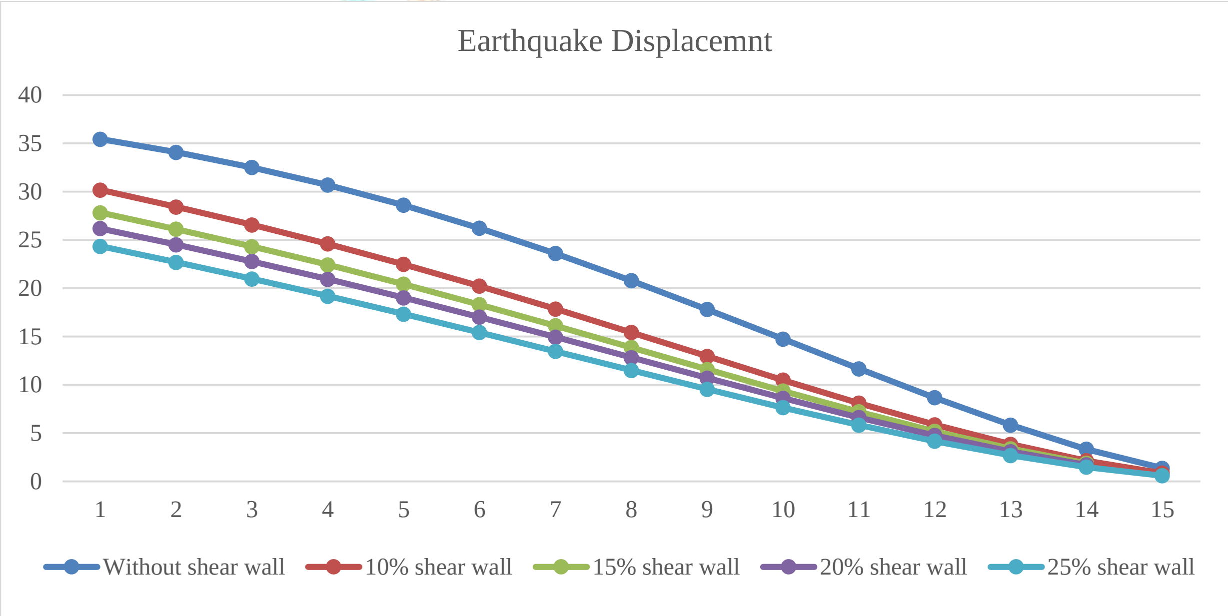


Table 5.1.11 Wind Displacement Results for G+15 Storey, Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

Diaphragm Centre of Mass Displacements							
Storey	**Load Case/Combo**	**UX(mm)**	**UX(mm)**	**UX(mm)**	**UX(mm)**	**UX(mm)**	**Point**
		Without shear wall	**10% shear wall**	**15% Base Shear**	**20% Base Shear**	**25% Base Shear**	
15th slab	WL+X	29.262	19.821	16.721	14.52	12.506	894
14th slab	WL+X	28.314	18.781	15.783	13.669	11.71	895
13th slab	WL+X	27.232	17.682	14.802	12.783	10.889	896
12th slab	WL+X	25.965	16.504	13.761	11.851	10.036	897
11th slab	WL+X	24.48	15.233	12.651	10.864	9.146	898

10th slab	WL+X	22.763	13.866	11.469	9.821	8.218	899
9th slab	WL+X	20.813	12.405	10.219	8.725	7.257	900
8th slab	WL+X	18.638	10.861	8.912	7.587	6.271	901
7th slab	WL+X	16.262	9.255	7.563	6.419	5.273	902
6th slab	WL+X	13.72	7.615	6.196	5.244	4.28	903
5th slab	WL+X	11.064	5.98	4.844	4.087	3.314	904
4th slab	WL+X	8.371	4.398	3.547	2.983	2.403	905
3rd slab	WL+X	5.748	2.932	2.354	1.973	1.578	906
2nd slab	WL+X	3.349	1.658	1.325	1.108	0.879	907
1st slab	WL+X	1.39	0.673	0.536	0.447	0.352	908

Graph 5.1.11 Wind Displacement vs. Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

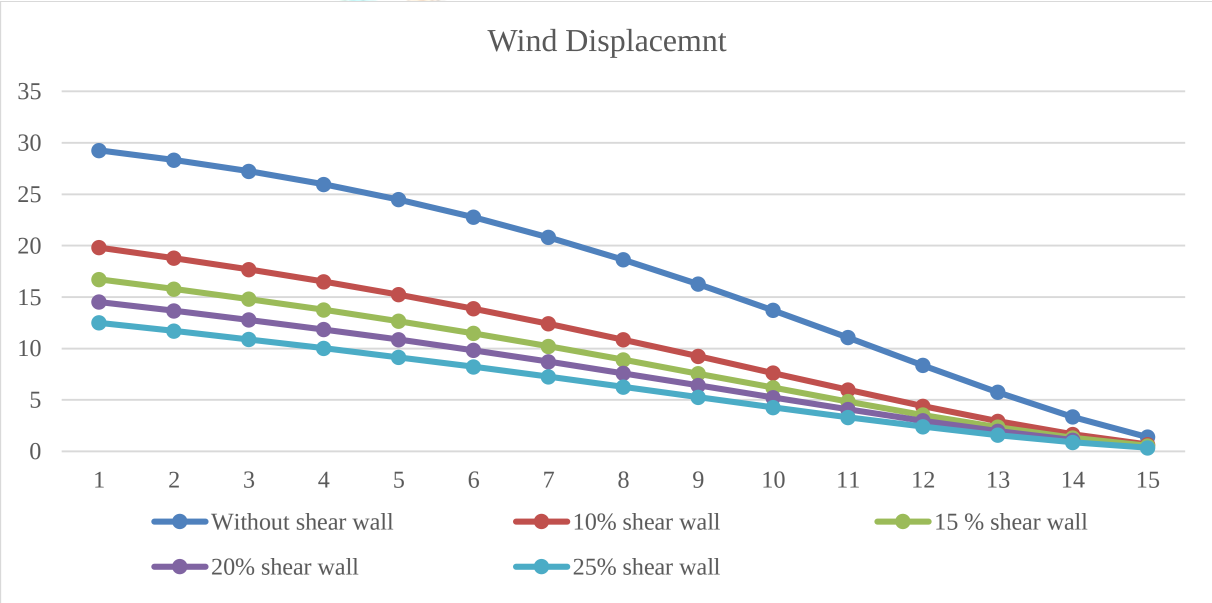
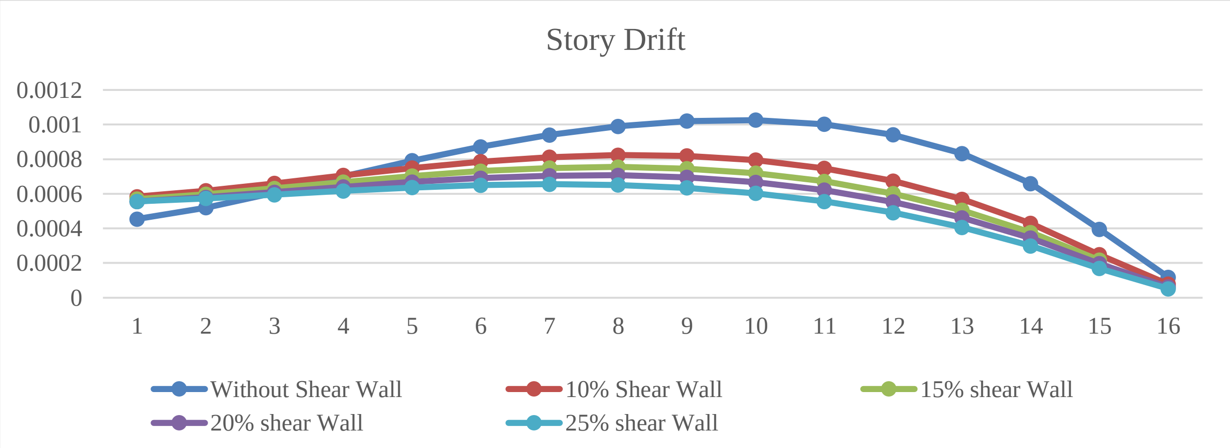


Table 5.1.12 Storey Drift Results for G+15 Storey, Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

TABLE: Storey Drifts							
Storey	**Load Case/Combo**	**Drift**	**Drift**	**Drift**	**Drift**	**Drift**	**Label**

		Without shear wall	10% shear wall	15% Base Shear	20% Base Shear	25% Base Shear	
15th slab	EQ+X	0.000454	0.000584	0.00057	0.000556	0.000556	43
14th slab	EQ+X	0.00052	0.000618	0.000597	0.00058	0.000573	43
13th slab	EQ+X	0.000607	0.00066	0.000632	0.000609	0.000595	43
12th slab	EQ+X	0.0007	0.000706	0.000668	0.00064	0.000617	43
11th slab	EQ+X	0.000791	0.000749	0.000703	0.000669	0.000636	43
10th slab	EQ+X	0.000872	0.000786	0.000731	0.000691	0.00065	43
9th slab	EQ+X	0.00094	0.000812	0.000749	0.000705	0.000656	43
8th slab	EQ+X	0.00099	0.000824	0.000755	0.000707	0.000651	43
7th slab	EQ+X	0.00102	0.000819	0.000745	0.000695	0.000634	43
6th slab	EQ+X	0.001026	0.000795	0.000719	0.000667	0.000603	43
5th slab	EQ+X	0.001002	0.000747	0.000672	0.000621	0.000556	43
4th slab	EQ+X	0.000941	0.000674	0.000601	0.000553	0.000491	43
3rd slab	EQ+X	0.000833	0.000569	0.000505	0.000462	0.000406	43
2nd slab	EQ+X	0.000659	0.000429	0.000377	0.000344	0.000299	43
1st slab	EQ+X	0.000395	0.000248	0.000217	0.000197	0.000169	43
P L	EQ+X	0.000118	0.000078	0.000068	0.000062	0.000052	24

Graph 5.1.12 Storey Drift for Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%



Rectangular Shape Structure

Table 5.2.1 Base Shear Results for G+15 Storey, Corner Locations Shear Wall Building and Periphery Location Shear Wall Building

Base shear - Auto Seismic - IS 1893:2002									
Load Pattern	**Z**	**Soil Type**	**I**	**R**	**Period Used**	**Coeff Used**	**Weight Used**	**Base Shear**	**Base Shear**
					sec		kN	kN	kN
EQ+X	0.16	II	1.2	5	1.755	0.014881	108571.7	1615.6475	1330.251
EQ-X	0.16	II	1.2	5	1.755	0.014881	108571.7	1615.6475	1330.251
EQ+Y	0.16	II	1	5	1.064	0.020448	108571.7	2220.0387	1252.749
EQ-Y	0.16	II	1	5	1.064	0.020448	108571.7	2220.0387	1252.749

Graph 5.2.1 Base Shear Results for Corner and Periphery Locations of Shear Wall

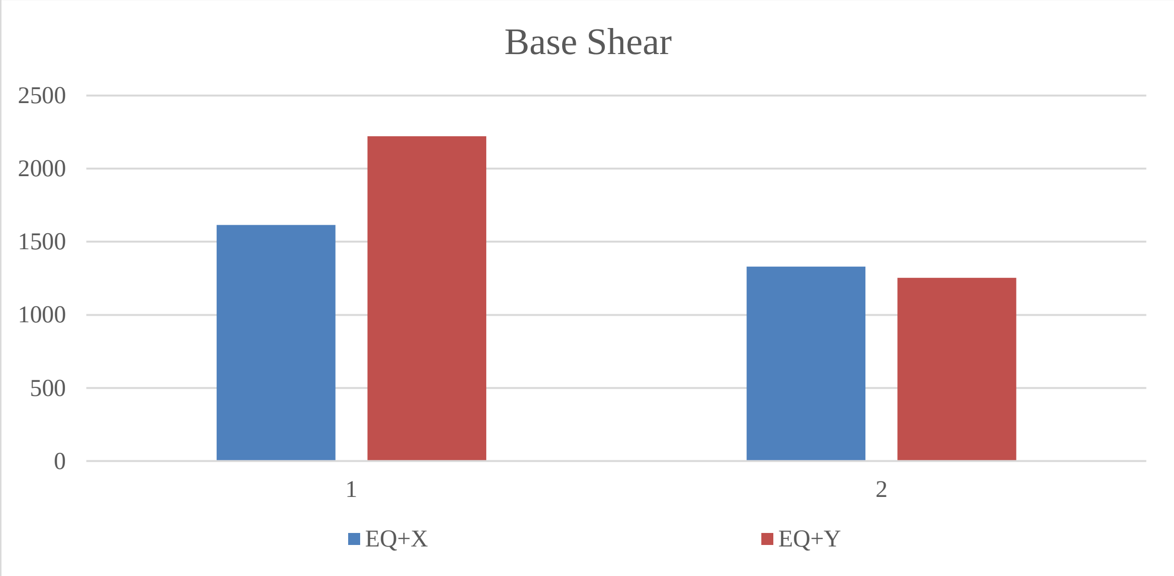


Table 5.2.2 Earthquake Displacement Results For G+15 Storey, Corner and Periphery Locations of Shear Wall

Diaphragm Centre of Mass Displacements							
Storey	**Load Case/Combo**	**UX**	**UX**	**Point**	**X**	**Y**	**Z**
		mm	mm		mm	mm	mm
15th slab	EQ+X	27.298	29.038	684	10000	14000	46500
14th slab	EQ+X	25.377	27.389	738	10000	14000	43500
13th slab	EQ+X	23.39	25.639	764	10000	14000	40500
12th slab	EQ+X	21.339	23.761	850	10000	14000	37500
11th slab	EQ+X	19.225	21.745	851	10000	14000	34500
10th slab	EQ+X	17.062	19.598	852	10000	14000	31500
9th slab	EQ+X	14.87	17.338	854	10000	14000	28500
8th slab	EQ+X	12.677	14.996	857	10000	14000	25500
7th slab	EQ+X	10.516	12.614	858	10000	14000	22500
6th slab	EQ+X	8.425	10.238	861	10000	14000	19500
5th slab	EQ+X	6.446	7.928	874	10000	14000	16500
4th slab	EQ+X	4.626	5.748	875	10000	14000	13500
3rd slab	EQ+X	3.019	3.778	876	10000	14000	10500
2nd slab	EQ+X	1.681	2.108	877	10000	14000	7500
1st slab	EQ+X	0.68	0.844	878	10000	14000	4500

Graph 5.2.2 Earthquake Displacement for Corner and Periphery Locations of Shear Wall

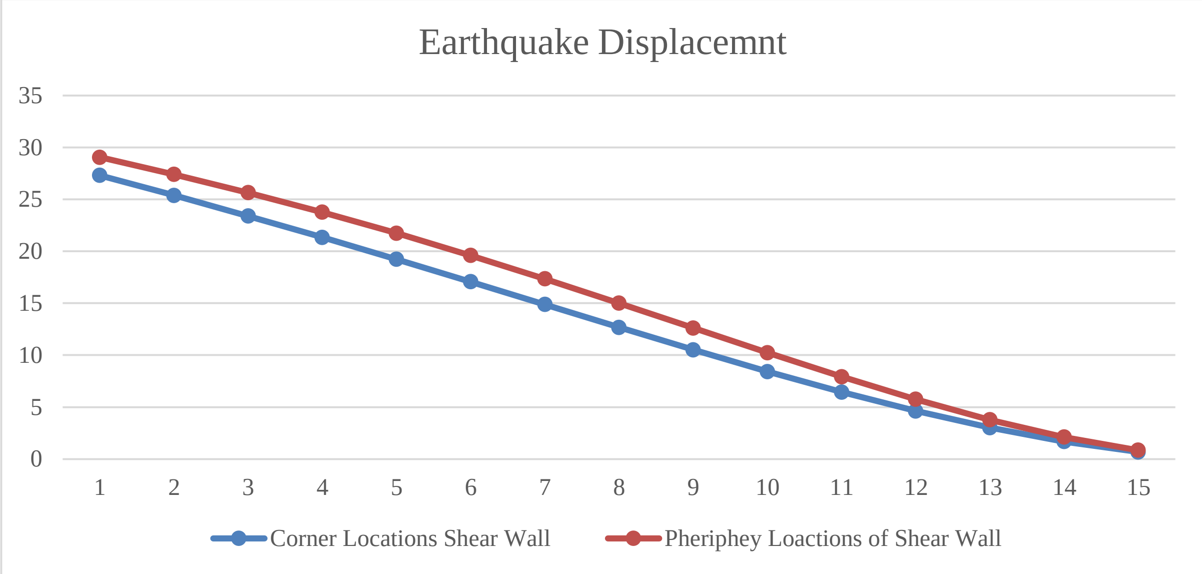


Table 5.2.3 Wind Displacement Results for G+15 Storey, Corner and Periphery locations of Shear Wall Building

Diaphragm Centre of Mass Displacements							
Storey	**Load Case/Combo**	**UX**	**UX**	**Point**	**X**	**Y**	**Z**
		mm	mm		mm	mm	mm
15th slab	WL+X	18.383	23.994	684	10000	14000	46500
14th slab	WL+X	17.17	22.77	738	10000	14000	43500
13th slab	WL+X	15.918	21.473	764	10000	14000	40500
12th slab	WL+X	14.625	20.076	850	10000	14000	37500
11th slab	WL+X	13.287	18.563	851	10000	14000	34500
10th slab	WL+X	11.906	16.927	852	10000	14000	31500
9th slab	WL+X	10.491	15.171	854	10000	14000	28500
8th slab	WL+X	9.052	13.309	857	10000	14000	25500
7th slab	WL+X	7.609	11.364	858	10000	14000	22500
6th slab	WL+X	6.183	9.37	861	10000	14000	19500
5th slab	WL+X	4.803	7.375	874	10000	14000	16500
4th slab	WL+X	3.505	5.439	875	10000	14000	13500
3rd slab	WL+X	2.328	3.637	876	10000	14000	10500
2nd slab	WL+X	1.323	2.066	877	10000	14000	7500
1st slab	WL+X	0.548	0.845	878	10000	14000	4500

Graph 5.2.3 Wind Displacement for Corner and Periphery locations of Shear Wall Buildings

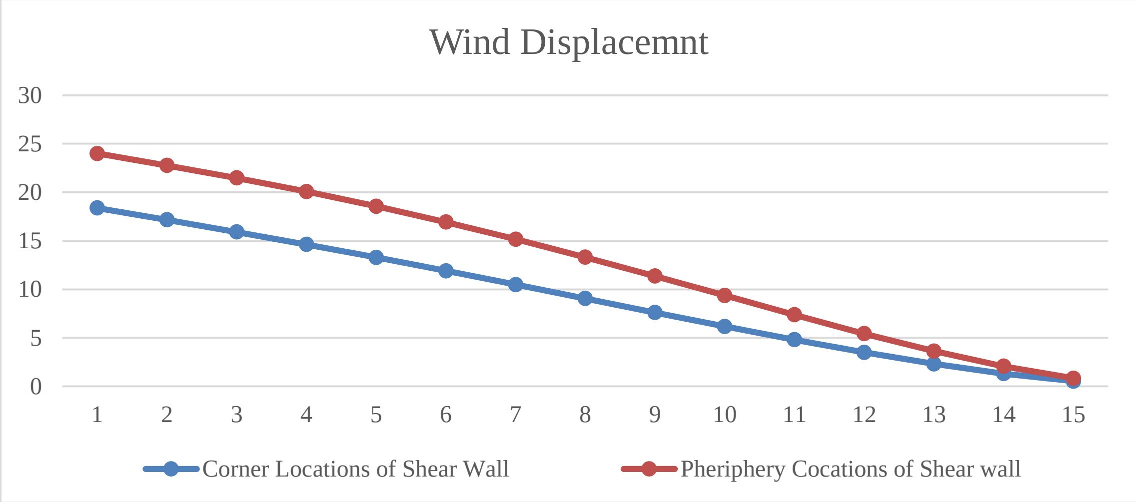


Table 5.2.4 Storey Drift Results for G+15 Storey, Without Shear Wall Building

Storey Drifts							
Storey	**Load Case/Combo**	**Drift**	**Drift**	**Label**	**X**	**Y**	**Z**
					mm	mm	mm
15th slab	EQ+X	0.00064	0.00055	36	20000	0	46500
14th slab	EQ+X	0.000662	0.000583	36	20000	0	43500
13th slab	EQ+X	0.000684	0.000626	36	20000	0	40500
12th slab	EQ+X	0.000705	0.000672	36	20000	0	37500
11th slab	EQ+X	0.000721	0.000716	36	20000	0	34500
10th slab	EQ+X	0.000731	0.000753	36	20000	0	31500
9th slab	EQ+X	0.000731	0.00078	36	20000	0	28500
8th slab	EQ+X	0.00072	0.000794	36	20000	0	25500
7th slab	EQ+X	0.000697	0.000792	36	20000	0	22500
6th slab	EQ+X	0.00066	0.00077	36	20000	0	19500
5th slab	EQ+X	0.000607	0.000726	36	20000	0	16500
4th slab	EQ+X	0.000536	0.000657	36	20000	0	13500
3rd slab	EQ+X	0.000446	0.000557	36	20000	0	10500
2nd slab	EQ+X	0.000334	0.000421	36	20000	0	7500
1st slab	EQ+X	0.000201	0.000245	36	20000	0	4500
P L	EQ+X	0.000086	0.00008	8	4000	0	1500

Graph 5.2.4 Storey Drift for Corner and Periphery Locations of Shear Walls

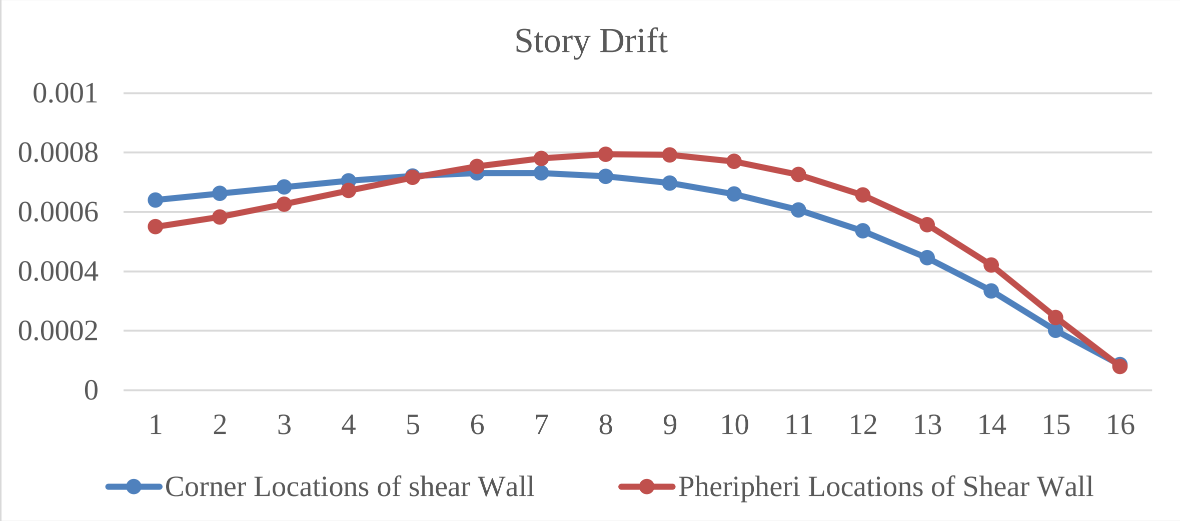


Table 5.2.5 Base Shear Results for G+15 Storey Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

Load Pattern	Z	Soil Type	I	R	Period Used	Base Shear	Base Shear	Base Shear
					sec	kN	kN	kN
EQ+X	0.16	II	1.2	5	2.51	1047.2172	4017.717	1927.638
EQ-X	0.16	II	1.2	5	2.51	1047.2172	4017.717	1927.638
EQ+Y	0.16	II	1	5	1.355	1617.2405	3324.55	711.1587
EQ-Y	0.16	II	1	5	1.355	1617.2405	3324.55	711.1587

Graph 5.2.5 Base Shear Results for Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

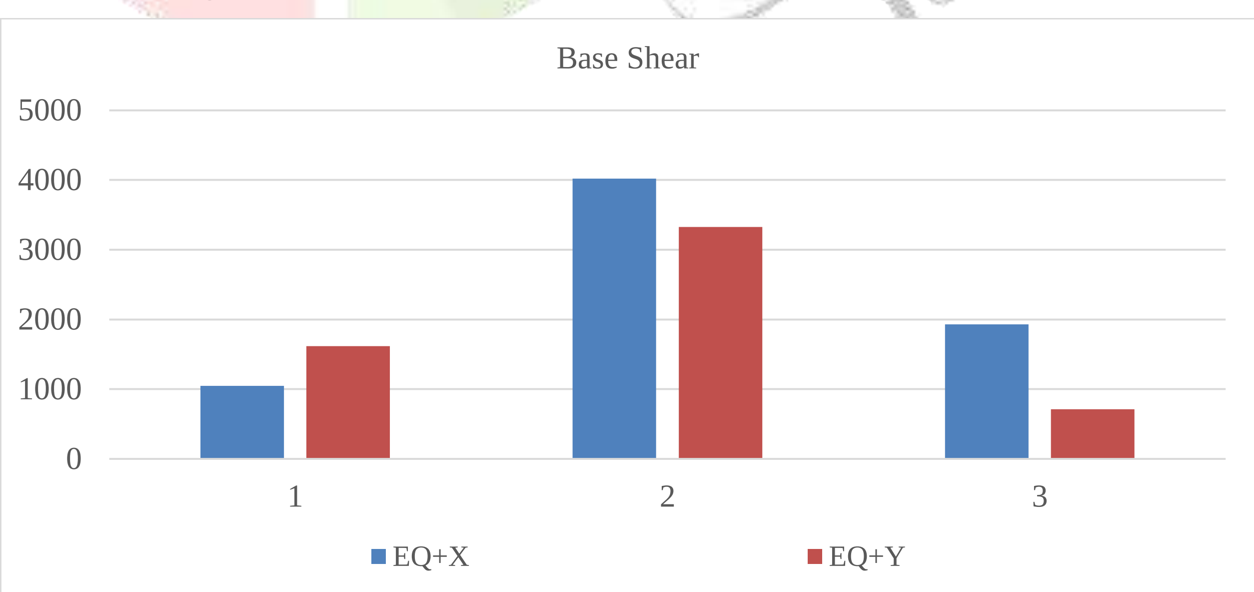


Table 5.2.6 Earthquake Displacement Results for G+15 Storey, Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

Diaphragm Centre of Mass Displacements

Storey	Load Case / Combo	UX	UX	UX	Point	X	Y	Z
		mm	mm	mm		mm	mm	mm
15th slab	EQ+X	34.068	9.939	20.811	396	10028.73	13943.91	46500
14th slab	EQ+X	32.995	9.205	19.384	414	10061.77	13907.88	43500
13th slab	EQ+X	31.655	8.447	17.917	450	10061.77	13907.88	40500
12th slab	EQ+X	29.971	7.669	16.392	468	10061.77	13907.88	37500
11th slab	EQ+X	27.932	6.876	14.808	504	10061.77	13907.88	34500
10th slab	EQ+X	25.562	6.077	13.173	558	10061.77	13907.88	31500
9th slab	EQ+X	22.905	5.28	11.501	576	10061.77	13907.88	28500
8th slab	EQ+X	20.019	4.495	9.815	612	10061.77	13907.88	25500
7th slab	EQ+X	16.972	3.733	8.142	630	10061.77	13907.88	22500
6th slab	EQ+X	13.848	3.006	6.516	702	10061.77	13907.88	19500
5th slab	EQ+X	10.762	2.323	4.971	720	10061.77	13907.88	16500
4th slab	EQ+X	7.875	1.7	3.558	792	10058.1	13875.3	13500
3rd slab	EQ+X	5.292	1.15	2.314	853	10055.03	13840.07	10500
2nd slab	EQ+X	3.017	0.679	1.278	856	10055.03	13840.07	7500
1st slab	EQ+X	1.227	0.305	0.513	859	10055.03	13840.07	4500

Graph 5.2.6 Earthquake Displacement for Longer Span Locations, Mid Span and Shorter span Location Shear Wall Building

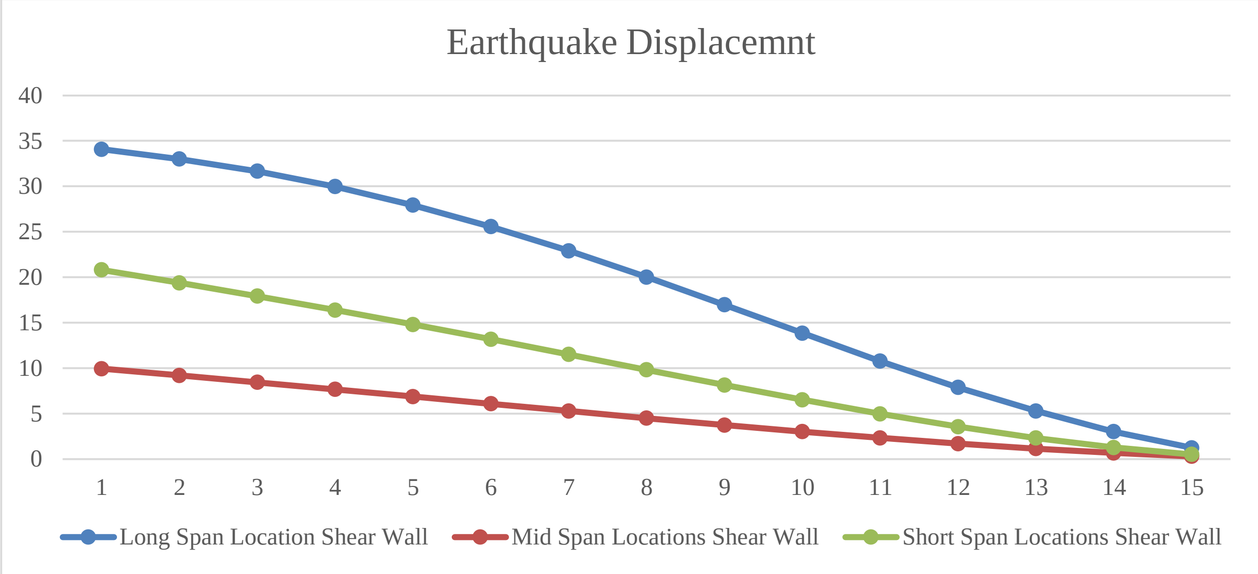


Table 5.2.7 Wind Displacement Results for G+15 Storey, Longer Span Locations, Mid Span and Shorter Span Location Shear Wall Building

Diaphragm Centre of Mass Displacements									
Storey	Diaphragm	Load Case/Combo	UX	UX	UX	Point	X	Y	Z
			mm	mm	mm		mm	mm	mm
15th slab	D1	WL+X	36.09	2.679	11.687	396	10028.73	13943.91	46500
14th slab	D1	WL+X	35.161	2.491	10.946	414	10061.77	13907.88	43500
13th slab	D1	WL+X	34.014	2.299	10.186	450	10061.77	13907.88	40500
12th slab	D1	WL+X	32.567	2.103	9.393	468	10061.77	13907.88	37500
11th slab	D1	WL+X	30.782	1.902	8.563	504	10061.77	13907.88	34500
10th slab	D1	WL+X	28.645	1.699	7.697	558	10061.77	13907.88	31500
9th slab	D1	WL+X	26.157	1.494	6.798	576	10061.77	13907.88	28500
8th slab	D1	WL+X	23.339	1.29	5.875	612	10061.77	13907.88	25500
7th slab	D1	WL+X	20.227	1.089	4.94	630	10061.77	13907.88	22500
6th slab	D1	WL+X	16.885	0.892	4.01	702	10061.77	13907.88	19500
5th slab	D1	WL+X	13.42	0.704	3.105	720	10061.77	13907.88	16500
4th slab	D1	WL+X	10.008	0.527	2.256	792	10058.1	13875.3	13500
3rd slab	D1	WL+X	6.827	0.365	1.491	853	10055.03	13840.07	10500
2nd slab	D1	WL+X	3.953	0.223	0.837	856	10055.03	13840.07	7500

1st slab	D1	WL+X	1.634	0.104	0.342	859	10055.03	13840.07	4500

Graph 5.2.7 Wind Displacement for Longer Span Locations, Mid Span and Shorter Span Location Shear Wall Buildings

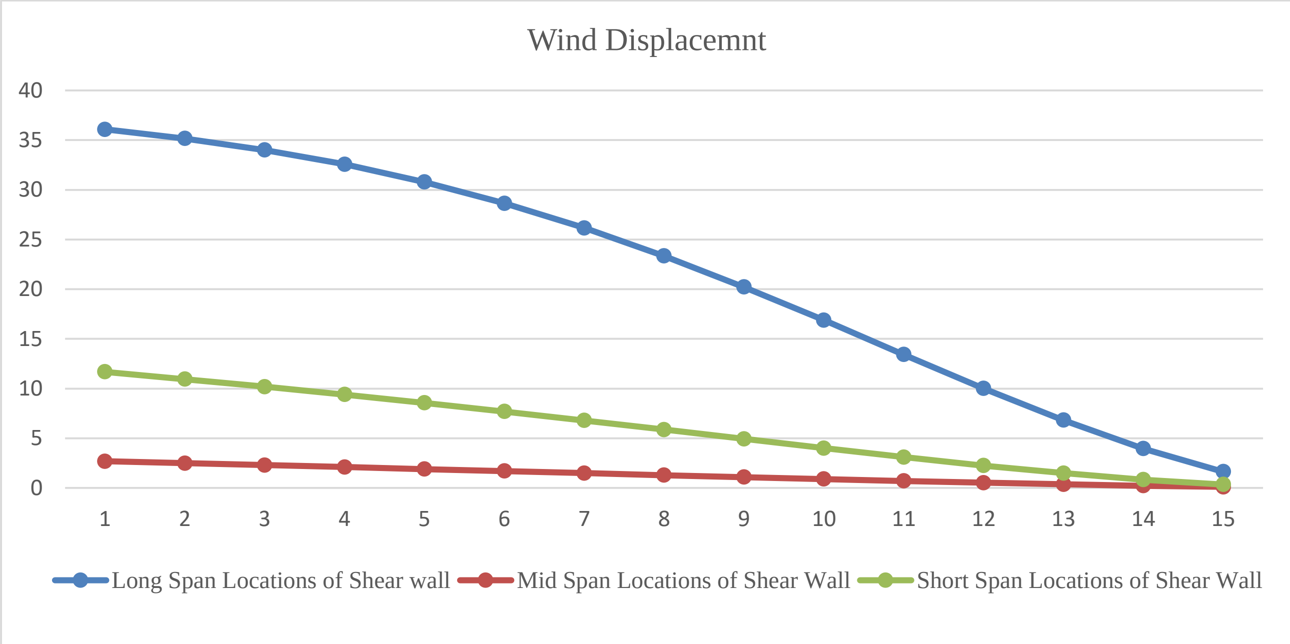


Table 5.2.8 Storey Drift Results for G+15 Storey, Longer Span Locations, Mid Span and Shorter Span Location Shear Wall Building

Storey Drifts								
Storey	**Load Case /Combo**	**Direction**			**Label**	**X**	**Y**	**Z**
		Drift	**Drift**	**Drift**		mm	mm	mm
15th slab	EQ+X	0.000363	0.000245	0.000528	36	20000	0	46500
14th slab	EQ+X	0.000451	0.000253	0.000548	36	20000	0	43500
13th slab	EQ+X	0.000564	0.00026	0.000574	36	20000	0	40500
12th slab	EQ+X	0.00068	0.000265	0.000601	36	20000	0	37500
11th slab	EQ+X	0.000791	0.000267	0.000626	70	20000	28000	34500
10th slab	EQ+X	0.000889	0.000266	0.000644	70	20000	28000	31500
9th slab	EQ+X	0.000967	0.000262	0.000653	70	20000	28000	28500
8th slab	EQ+X	0.001023	0.000255	0.000652	70	20000	28000	25500

7th slab	EQ+X	0.00105	0.000243	0.000636	70	20000	28000	22500
6th slab	EQ+X	0.00104	0.000228	0.000606	70	20000	28000	19500
5th slab	EQ+X	0.000976	0.000208	0.000557	70	20000	28000	16500
4th slab	EQ+X	0.000876	0.000184	0.000489	70	20000	28000	13500
3rd slab	EQ+X	0.000774	0.000158	0.000409	70	20000	28000	10500
2nd slab	EQ+X	0.00061	0.000125	0.000304	70	20000	28000	7500
1st slab	EQ+X	0.000366	0.000088	0.000178	65	0	28000	4500
P L	EQ+X	0.000122	0.00006	0.000083	28	12000	24000	1500

Graph 5.2.8 Storey Drift for Corner and Periphery Locations of Shear Wall

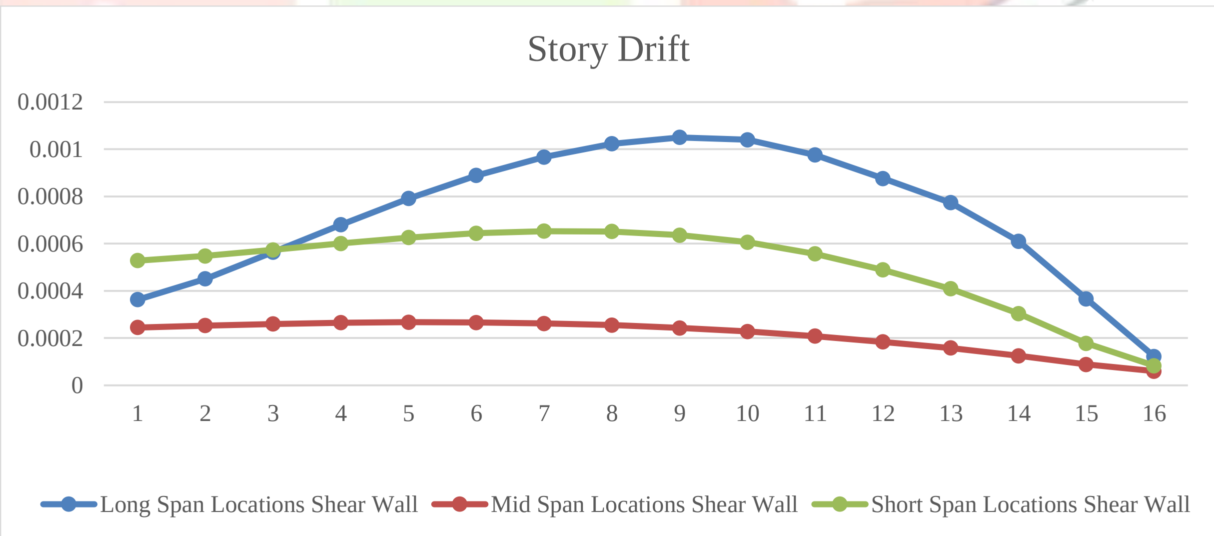


Table 5.2.9 Base Shear Results for G+15 Storey, Without Shear Wall Building, with shear Wall i.e. 10%, 15%, 20% and 25%

Base shear - Auto Seismic - IS 1893:2002									
Load Pattern	**Z**	**Soil Type**	**I**	**R**	**Base Shear**	**Base Shear**	**Base Shear**	**Base Shear**	**Base Shear**
					kN	kN	kN	kN	kN
EQ+X	0.16	II	1.2	5	1247.7166	1293.471	1419.855	1463.645	1525.533

EQ-X	0.16	II	1.2	5	1247.7166	1293.471	1419.855	1463.645	1525.533
EQ+Y	0.16	II	1	5	830.5517	1097.258	1098.743	1153.513	1214.424
EQ-Y	0.16	II	1	5	830.5517	1097.258	1098.743	1153.513	1214.424

Graph 5.2.9 Base Shear Results for Without Shear Wall Building, with shear Wall i.e. 10%, 15%, 20% and 25%

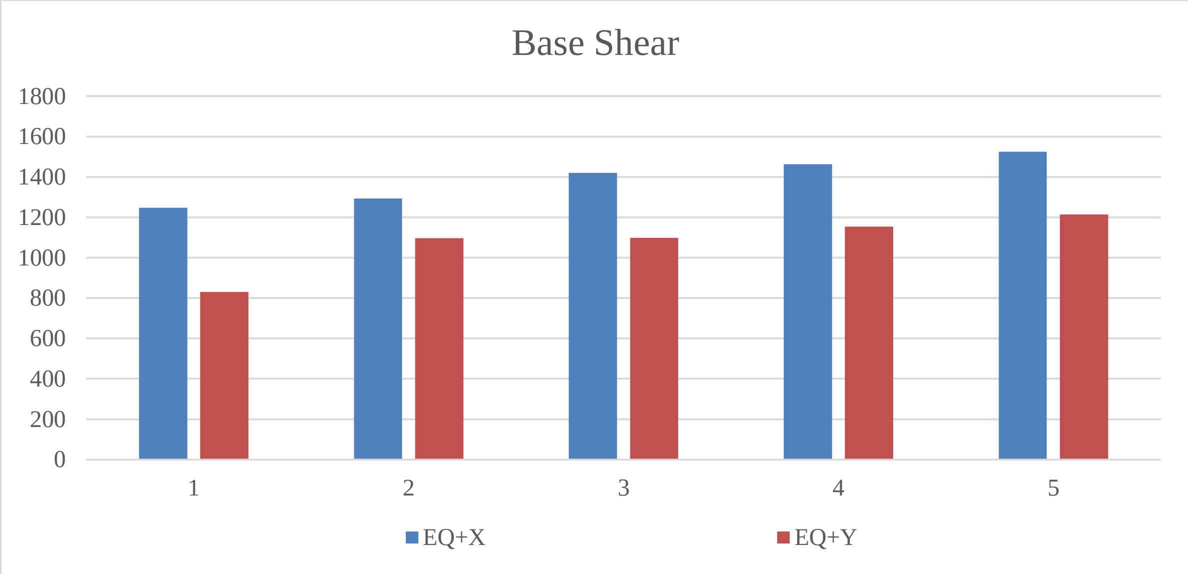


Table 5.2.10 Earthquake Displacement Results for G+15 Storey, Without Shear Wall Building, with shear Wall i.e. 10%, 15%, 20% and 25%

Diaphragm Centre of Mass Displacements										
Storey	Load Case /Combo	UX	UX	UX	UX	UX	Point	X	Y	Z
		mm	mm	mm	mm	mm		mm	mm	mm
15th slab	EQ+X	33.242	30.712	28.713	27.656	26.721	875	10000	14000	46500
14th slab	EQ+X	31.752	29.059	26.996	25.967	25.052	876	10000	14000	43500
13th slab	EQ+X	30.05	27.269	25.177	24.189	23.3	877	10000	14000	40500
12th slab	EQ+X	28.072	25.307	23.233	22.297	21.447	878	10000	14000	37500
11th slab	EQ+X	25.803	23.162	21.154	20.286	19.486	879	10000	14000	34500
10th slab	EQ+X	23.261	20.843	18.951	18.162	17.424	880	10000	14000	31500
9th slab	EQ+X	20.49	18.38	16.646	15.95	15.283	882	10000	14000	28500
8th slab	EQ+X	17.553	15.816	14.277	13.68	13.093	883	10000	14000	25500

7th slab	EQ+X	14.533	13.207	11.889	11.395	10.895	884	10000	14000	22500
6th slab	EQ+X	11.536	10.621	9.54	9.148	8.738	885	10000	14000	19500
5th slab	EQ+X	8.698	8.142	7.295	6.997	6.676	886	10000	14000	16500
4th slab	EQ+X	6.194	5.878	5.238	5.016	4.78	887	10000	14000	13500
3rd slab	EQ+X	4.071	3.901	3.439	3.275	3.113	888	10000	14000	10500
2nd slab	EQ+X	2.263	2.213	1.92	1.811	1.716	889	10000	14000	7500
1st slab	EQ+X	0.895	0.925	0.779	0.718	0.676	890	10000	14000	4500

Graph 5.2.10 Earthquake Displacement for Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

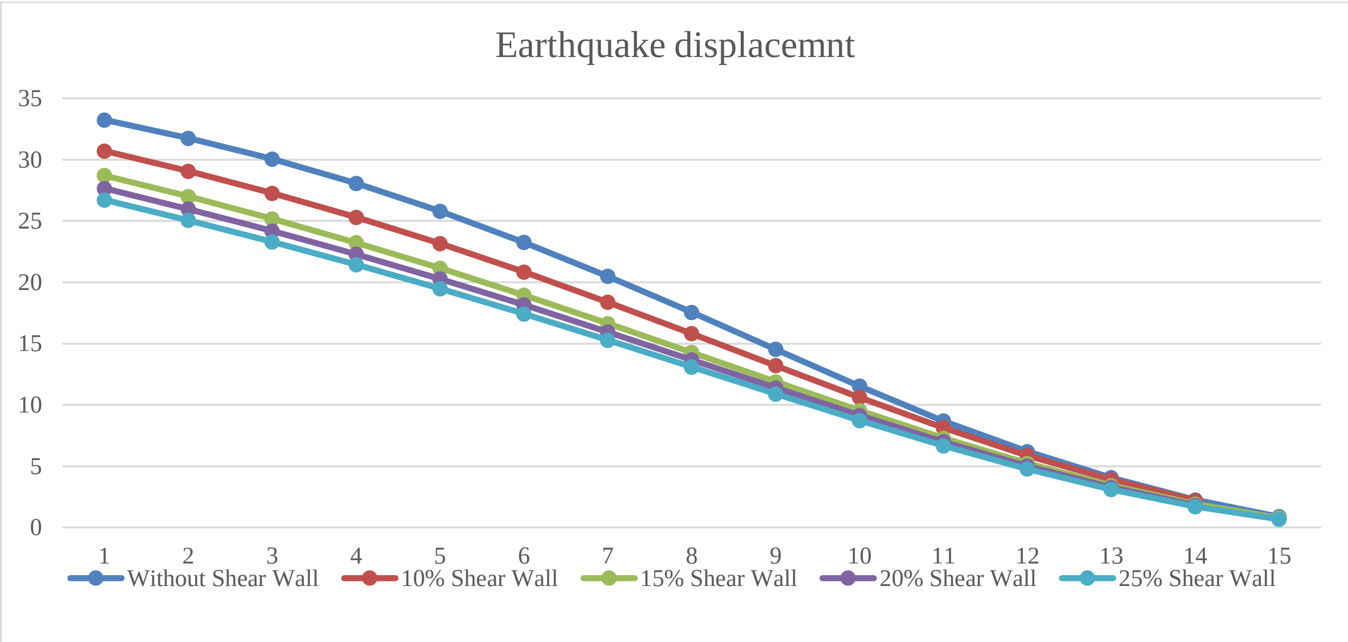


Table 5.2.11 Wind Displacement Results for G+15 Storey, Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

Diaphragm Centre of Mass Displacements									
Storey	**Diaphragm**	**Load Case/Combo**					**X**	**Y**	**Z**
		UX	**UX**	**UX**	**UX**	**UX**	mm	mm	mm
15th slab	WL+X	29.046	25.979	22.067	20.615	19.095	10000	14000	46500
14th slab	WL+X	27.927	24.743	20.877	19.474	18.008	10000	14000	43500
13th slab	WL+X	26.652	23.406	19.617	18.273	16.87	10000	14000	40500
12th slab	WL+X	25.166	21.936	18.266	16.992	15.661	10000	14000	37500
11th slab	WL+X	23.435	20.31	16.808	15.618	14.372	10000	14000	34500
10th slab	WL+X	21.452	18.521	15.24	14.147	12.998	10000	14000	31500
9th slab	WL+X	19.226	16.576	13.568	12.585	11.546	10000	14000	28500
8th slab	WL+X	16.787	14.496	11.808	10.948	10.03	10000	14000	25500
7th slab	WL+X	14.187	12.315	9.988	9.258	8.47	10000	14000	22500

6th slab	WL+X	11.506	10.084	8.147	7.551	6.899	10000	14000	19500
5th slab	WL+X	8.861	7.872	6.336	5.871	5.357	10000	14000	16500
4th slab	WL+X	6.422	5.779	4.624	4.277	3.896	10000	14000	13500
3rd slab	WL+X	4.277	3.892	3.081	2.836	2.577	10000	14000	10500
2nd slab	WL+X	2.411	2.242	1.748	1.594	1.445	10000	14000	7500
1st slab	WL+X	0.967	0.952	0.721	0.643	0.58	10000	14000	4500

Graph 5.2.11 Wind Displacement vs. Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%

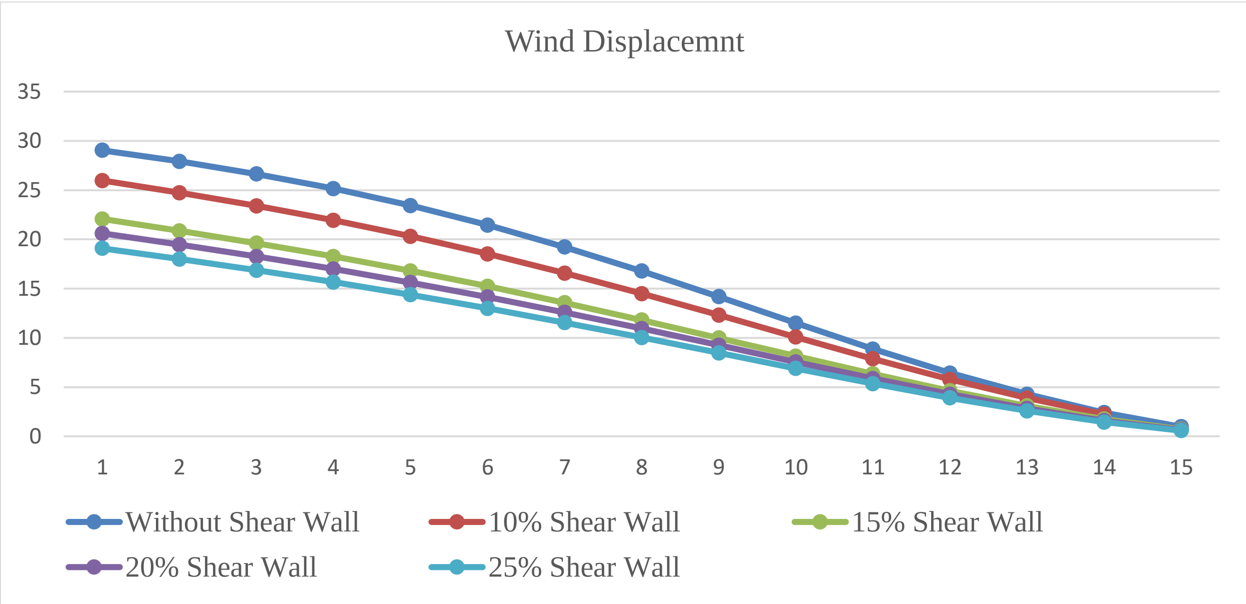
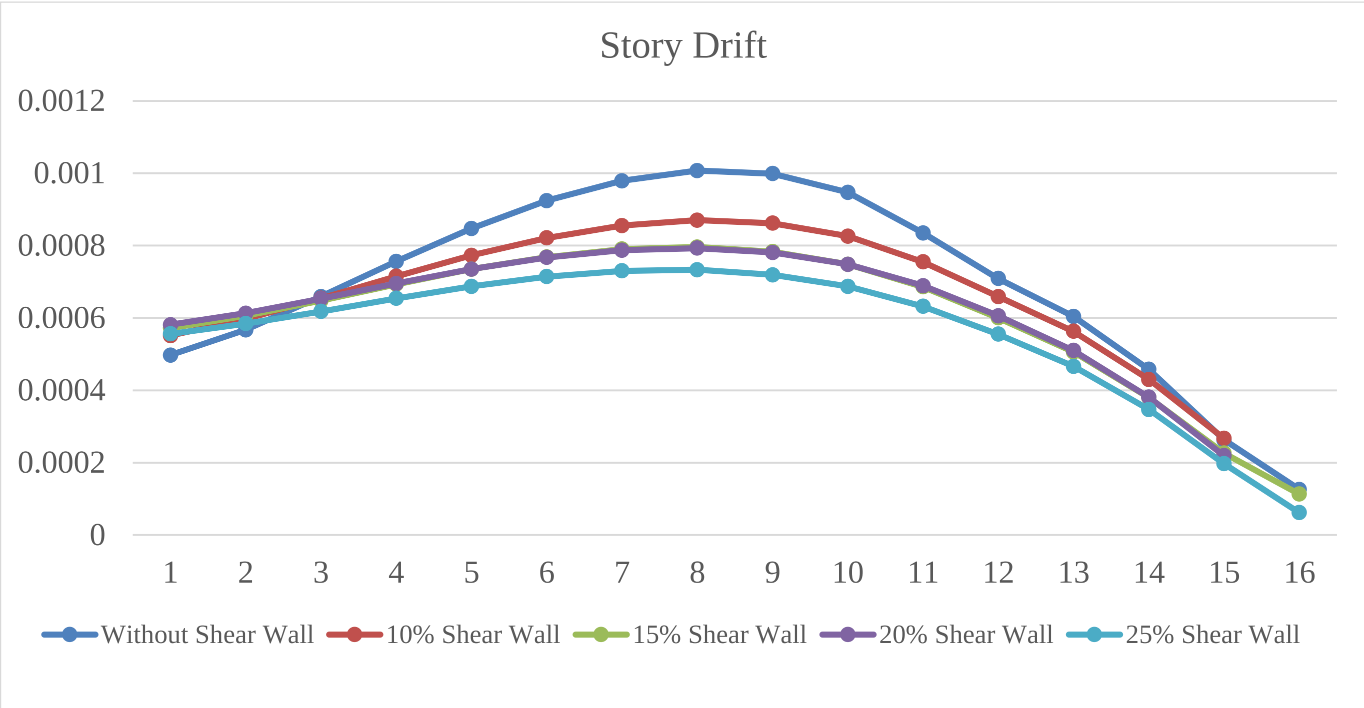


Table 5.2.12 Storey Drift Results for G+15 Storey, Without Shear Wall Building, and With Shear Wall i.e. 10%, 15%, 20% and 25%

Storey Drifts									
Storey	**Load Case /Combo**	**Direction**					**X**	**Y**	**Z**
		Drift	**Drift**	**Drift**	**Drift**	**Drift**	mm	mm	mm
15th slab	EQ+X	0.000497	0.000551	0.000572	0.000581	0.000556	20000	0	46500
14th slab	EQ+X	0.000567	0.000597	0.000606	0.000613	0.000584	20000	0	43500
13th slab	EQ+X	0.000659	0.000654	0.000648	0.000653	0.000618	20000	0	40500
12th slab	EQ+X	0.000756	0.000715	0.000693	0.000695	0.000654	20000	0	37500
11th slab	EQ+X	0.000847	0.000773	0.000735	0.000735	0.000687	20000	0	34500
10th slab	EQ+X	0.000924	0.000821	0.000768	0.000767	0.000714	20000	0	31500
9th slab	EQ+X	0.000979	0.000855	0.00079	0.000787	0.00073	20000	0	28500
8th slab	EQ+X	0.001007	0.00087	0.000796	0.000793	0.000733	20000	0	25500
7th slab	EQ+X	0.000999	0.000862	0.000783	0.000781	0.000719	20000	0	22500
6th slab	EQ+X	0.000947	0.000826	0.000748	0.000748	0.000687	20000	0	19500
5th slab	EQ+X	0.000835	0.000755	0.000686	0.000689	0.000632	20000	0	16500

4th slab	EQ+X	0.000709	0.000659	0.0006	0.000606	0.000555	20000	0	13500
3rd slab	EQ+X	0.000604	0.000563	0.000506	0.00051	0.000466	20000	0	10500
2nd slab	EQ+X	0.000458	0.00043	0.00038	0.000381	0.000347	20000	0	7500
1st slab	EQ+X	0.000263	0.000267	0.000226	0.000219	0.000197	0	0	4500
P L	EQ+X	0.000126	0.000139	0.000113	0.000094	0.000062	0	8000	1500

Graph 5.2.12 Storey Drift for Without Shear Wall Building, With Shear Wall i.e. 10%, 15%, 20% and 25%



CHAPTER 6

CONCLUSIONS

6.1 Conclusions

In the present study, relative analysis of RCC Building G+15 Storey with different shape of building i.e. Square shape and Rectangular shape of building in medium soil is carried out. The structures are analysed for earthquake zone III with medium soil and results are compared. It has been made on different structural parameters viz. base shear, earthquake displacement, wind displacement, and storey drift etc. Grounded on the analysis results, following conclusions are drawn:

1. Analysis of RCC building with different shape of building i.e. Square shape and Rectangular shape of building with medium soil condition at zone II, the base shear in x- direction in periphery locations shear wall building, the base shear is increased 1.324 times as compared to corner locations of shear

wall building. Also in longer span, mid span and short span locations of shear wall, base shear in X- direction, mid span locations of shear wall building, the base shear is increased 1.4 times as compared to longer and shorter span locations of shear wall building. Similarly, in Without shear wall building, 10% Shear wall, 15% shear wall, 20% Shear wall and 25% shear wall, base shear is increased by 56%, 26%, 16% and 7.5% respectively as compared to 25% shear wall.

2. The Structure, corner locations of shear wall and periphery locations of shear wall also in longer span locations of shear wall, mid span locations of shear wall and short span locations of shear wall building with analysis for zone III with medium soil was carried out. But results indicate that variation of base shear increases in Periphery locations of shear wall building and Mid span locations of shear wall building, as compared to different types of shear wall building, means self-weight of regular Shear wall structure is maximum hence Periphery locations of shear wall building and Mid span locations of shear wall building is economical as compared to other types of shear wall building.

3. Regarding the earthquake displacement in different shape of shear wall building as compared to various locations of shear wall in building, displacement is minimum in Periphery locations of shear wall and mid span locations of shear wall i.e. 21.52% and 15.57% as compared to other different locations of shear wall building but relatively both building shows good performance in earthquake displacement.

4. Regarding the wind displacement in different shape of shear wall building as compared to various locations of shear wall in building, displacement is minimum in Periphery locations of shear wall and mid span locations of shear wall i.e. 9.345% and 5.57% as compared to other different locations of shear wall building but relatively both building shows good performance in wind displacement.

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