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Seismic Analysis of RCC Building without and With Shear Walls

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Abstract - *In this research work, we analysed the G+15 storey without shear walls RCC building and with using shear walls RCC building. The adopted building plan configuration as 36mX36m along to length and width respectively. 3.2 m each floors height with 230mm thick brick wall while 200mm thick shear wall and also for this analysis work, provided various properties like size of column 450mmX350mm, beams 400mmX300mm, thickness of slab 180mm thick, M25 grade of concrete for slabs and M30 grade concrete for beams and columns and Fe415 grade of steel and also used various seismic parameters such as seismic zone III, zone factor 0.16 with medium soil condition, Importance factor 1.5, damping ration 5 percent for factor 1, response reduction factor 5 for Special RC moment resisting frame structure. The analysis is done by Response Spectrum Method with the help of Etabs Software as per Indian Standard Code and compared the results in the term of Maximum shear wall moments and maximum deflections, storey drift etc.*

Key Words: Seismic Zone, Zone Factor, Soil, Shear Wall, RCC Building, High Rise Buildings etc.

1. INTRODUCTION

Multistoried building is the most important for day to day life. For earthquake resistant design of building wrong construction practices and ignorance were done in our country, most of the existing building affects to future earthquake. To prevent structural collapse, safety life and serviceability, effective structural system should be providing with all seismic performance. To get sufficient stiffness to the high rise buildings for resistance to lateral loads due to wind or seismic events. The location of building with reinforced concrete shear wall are designed because of their high bearing capacity, high ductility and rigidity. The dimensions of beam and column are large and reinforcement at beam column joint are quite heavy in high rise building, so lot of clogging at these joint and difficult to place and vibrate concrete at these places which is not safe for the buildings. Shear wall is used to overcome this problem in high rise building. ETABS is the software which is easy to use for analysis and design for developed specifically for building systems in High rise buildings. ETAB software are quick and easy for the simple, largest and most complex building. Although quick and easy for simple structures. It is the best tool for structural engineer in the construction industry. Shear walls should have sufficient ductility to avoid brittle failure under the action of strong lateral earthquake forces.

Tall buildings have intent mankind from the creation of advancement, their construction initially for the protection and consequently for clerical purpose. In any high rise structure, shear walls are the structural system to provide the stability to the structure from lateral force like due to its self-loads and other moving or living loads which is designed by earthquake analysis or wind analysis. Since shear wall structure more stable due to their supporting area like total cross sectional area of the shear wall with the reference to total plans area of the structure is comparatively more unlike the RCC framed structures.

Building Configuration

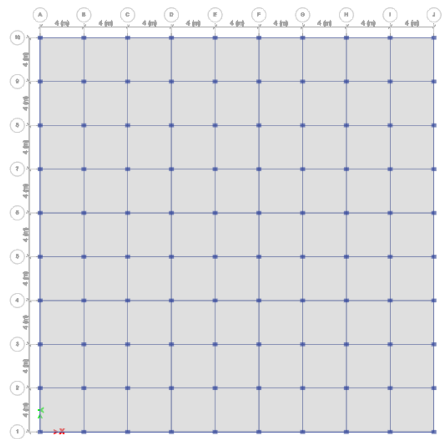


Fig.1.1 Model-I: Without Shear Wall

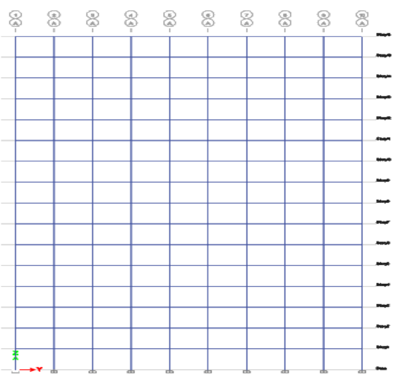


Fig. 1.2 Elevation

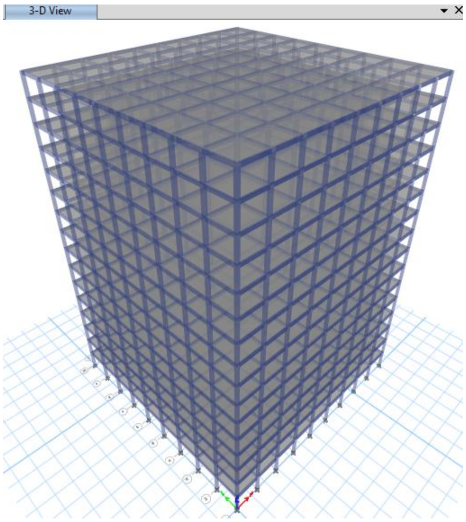
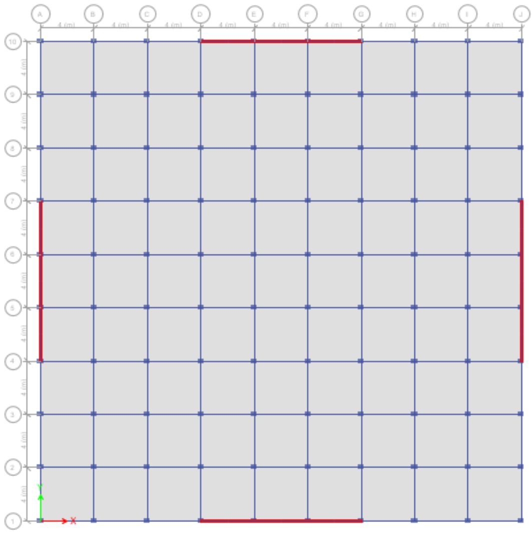
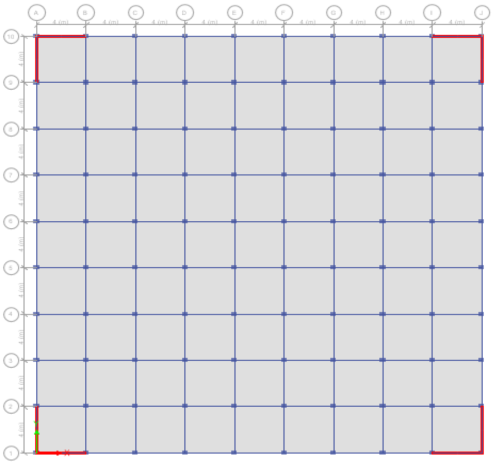


Fig. 1.3 Model-I 3-D View Without shear wall





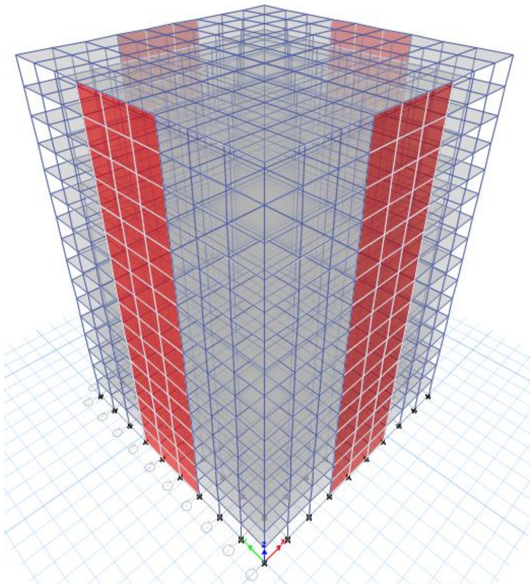


Fig. 1.5 Model-III with Shear Wall

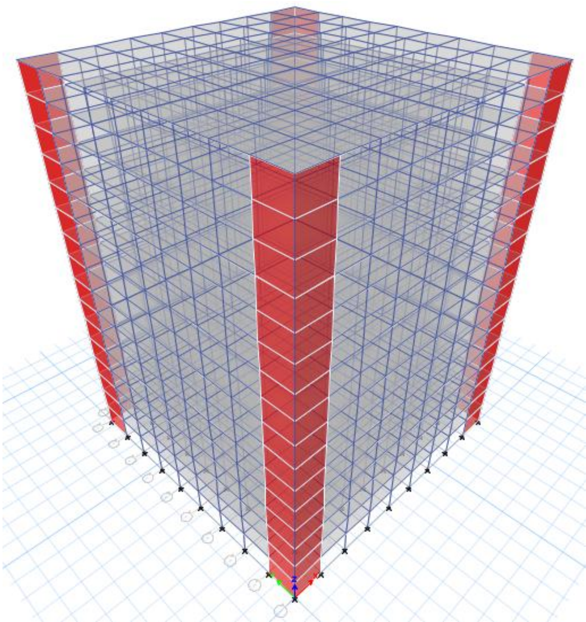
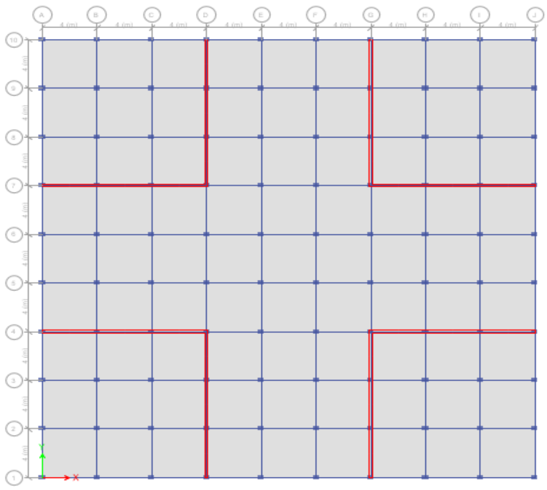


Fig. 1.4 Model-II with shear Wall



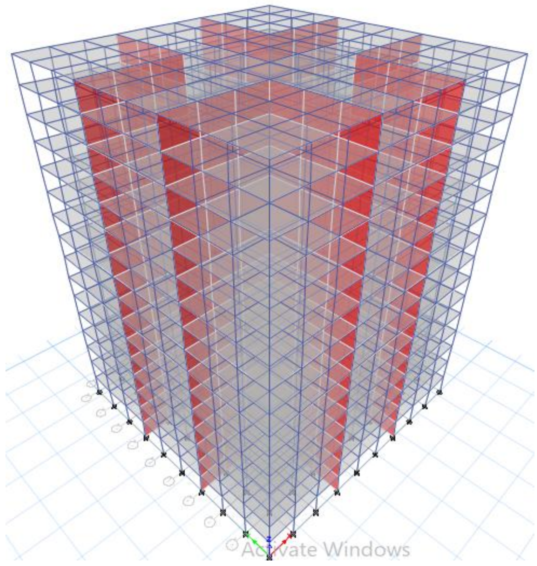
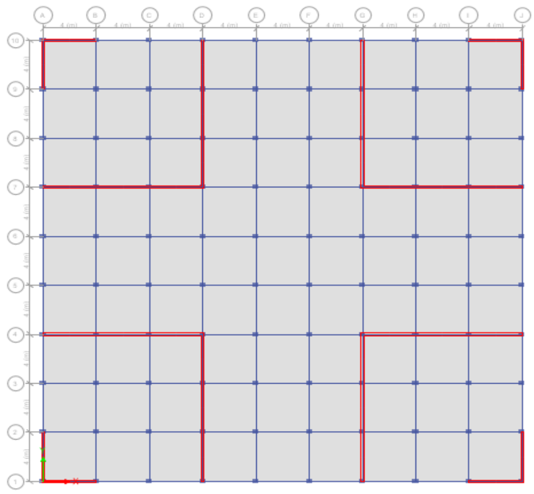


Fig. 1.6 Model-IV With Shear Wall



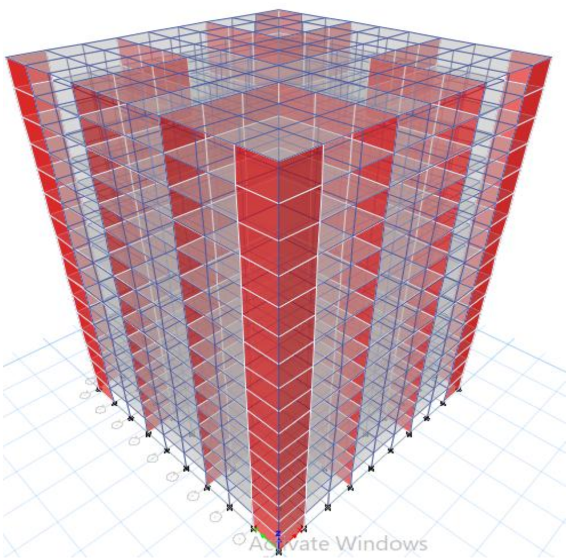


Fig. 1.7 Model-V with Shear Wall

Objectives of work:

1) To determine dynamic analysis of the building structure by proving different position of shear wall.

2) To investigate optimum location of shear wall of the structure.

3) To reduce lateral force impacts by considering shear walls in the structure.

2. LITRETURE REVIEW

1. Khaja BegumAnad, N Mightraj C, Prince Arulraj G. {2010}- They analyzed and designed the reinforced concrete subjected to earthquake force in the space framed structure with and without shear wall of fifteen story with different soil conditions by using Response Spectrum Method in latest Civil Engineering Structural software ETABS as per IS:1893 (Part-I):2002. He observed that the base shear is same for all soil conditions, while changed the soil conditions as hard to medium, soft, after three story base shear increased and percentage decreased in base shear from 0 to 26.5% when soil change medium to hard and 0 to 18.50 % soft to medium soil and also found that the axial force, bending moment in columns lateral displacement increased when soil changed hard to medium and also medium to soft for all the framed structures.

2. Anil Gaharwal, Sushil Sharma {2016}- He examined that G+4 storey RCC building in the earthquake region four and applied different position of the shear walls like as at side, corner and center of the building and analyzed with and without shear wall structures. They analyzed RCC multistorey residential building by using structural software Staad Pro. They observed that minimum displacement and moment is found when the the shear wall provide at centre of the building and in without shear wall, maximum shear force is found at ground level as compared to with shear wall building.

3. Kiran Tikde, Rahul Patil, Dr. G.R. Gandhe {2016}- They examined that G+7 storey RC building with and without shear walls by using SAP2000 software. The model was analyzed and designed in seismic zone two and they are provided plane stiffness and strength to resist the lateral loads and support gravity loads and also provided he flexural member in the building to avoid the collapse the building under the earthquake forces. The analysis was completed by using the response spectrum method and time history methods. They observed that the base shear without and with shear wall was calculated by time history method and this method of analysis building without and with and without shear wall empirical valley (EI Centro 1979) earthquake recorded is used while storey drift for all storey was done by response spectrum method and found that after proving the shear walls, the behavior of RC frame structure t large extend and shear wall increased the strength and stiffness of the structures.

3. MATHEDOLOGY

This study is attempted in following steps in Etabs Software:

Step-I Selection of the configuration of the building with and without shear wall.

Step-II Selection of the Material properties.

Step-III Selection of Frame Properties.

Step-IV Assign of all the Frame Section property.

Step-V Apply Fixed Supports at Base of the Structure.

Step-VI Define, Apply Various Loads and Load Combinations.

Step-VII Apply Check for all Model.

Step-VIII Apply Run Analysis for model analysis.

Step-IX Display the Results and compile all the results.

4.MATERIAL AND GEOMERICAL PROPERTIES

Following material and geometrical properties have been considered in modeling: -

Density of RCC: 25 KN/m3, Density of Masonry: 20.KN/m3.The symmetrical structural plan of the structure is 36m X 36m along to X and Y direction respectively for all model with and without shear wall. The storey height of each floor is 3.2 meter. The RC sections of beams 400mm X 300mm and columns 450mm X 350mm, for all models with or without shear wall.

Parameter Using:

Type of Building: RC Framed Structure (with & without Shear wall), Number of Floor: G+15 (symmetrical), Size of Column = 450mm X 350mm, Beam = 400mm X 300mm, Shear wall= 200 mm thick, Height of each floor = 3.2m, Seismic Parameter: As per IS 1893-2002, Seismic Zone- III, Type of soil- Medium, Damping = 5% (as per table-3 clause 6.4.2), Zone factor for zone III, Z=0.16 Importance Factor I=1.5 (Important structure as per Table-6), Response Reduction Factor R=5 RC moment resisting designed as per (Table-7), Sa/g= Average acceleration coefficient (depend on Natural fundamental period).

5. RESULTS AND ANALYSIS

5.1: STOREY SHEAR

5.1.1: STOREY SHEAR IN MODEL-I WITHOUT SHEAR WALL

Table 5.1.1: Storey Shear (KN) in Model-I

MODEL-I			
WITHOUT SHEAR WALL			
Maximum Storey Shear in KN			
Storey	Elevation (m)	X - Direction	Y - Direction
Story16	51.2	612.5673	557.8704
Story15	48	1178.5434	1073.3099
Story14	44.8	1671.5714	1522.3149
Story13	41.6	2096.6824	1909.4672
Story12	38.4	2458.9071	2239.3484
Story11	35.2	2763.2764	2516.5403
Story10	32	3014.8214	2745.6245
Story9	28.8	3218.5728	2931.1827
Story8	25.6	3379.5615	3077.7966
Story7	22.4	3502.8185	3190.0479
Story6	19.2	3593.3747	3272.5182
Story5	16	3656.2609	3329.7892
Story4	12.8	3696.5081	3366.4427
Story3	9.6	3719.1472	3387.0603
Story2	6.4	3729.209	3396.2236
Story1	3.2	3731.7244	3398.5145
Base	0	0	0

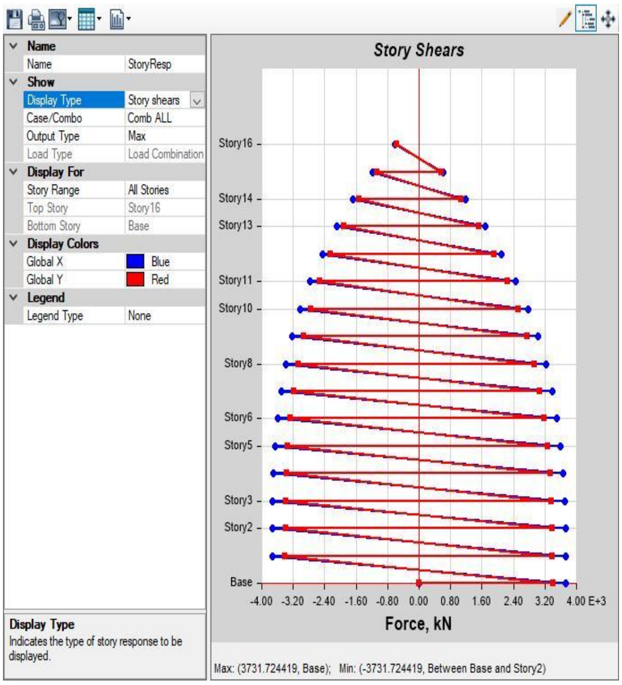


Fig 5.1.1: Storey Shear in Model-I without Shear Wall

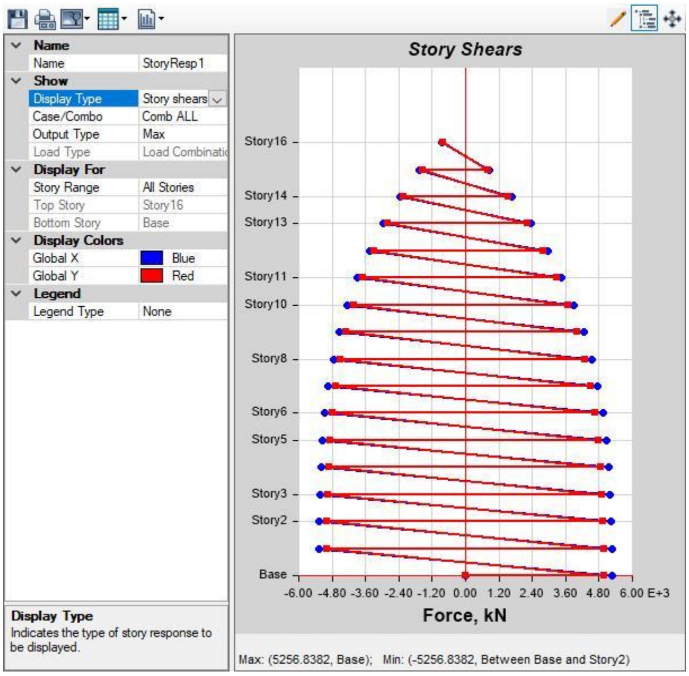


Fig 5.1.2: Storey Shear in Model-II with Shear Wall

5.1.2: STOREY SHEAR IN MODEL-II WITH SHEAR WALL

Table 5.1.2: Storey Shear (KN) in Model-II

MODEL-II			
WITH SHEAR WALL			
Maximum Storey Shear in KN			
Storey	Elevation (m)	X - Direction	Y - Direction
Story16	51.2	844.5432	798.6473
Story15	48	1645.1612	1555.7565
Story14	44.8	2342.5885	2215.2828
Story13	41.6	2943.9416	2783.9559
Story12	38.4	3456.3372	3268.5058
Story11	35.2	3886.8918	3675.6623
Story10	32	4242.722	4012.1553
Story9	28.8	4530.9445	4284.7147
Story8	25.6	4758.6759	4500.0702
Story7	22.4	4933.0327	4664.9517
Story6	19.2	5061.1316	4786.0892
Story5	16	5150.0891	4870.2125
Story4	12.8	5207.022	4924.0513
Story3	9.6	5239.0467	4954.3357
Story2	6.4	5253.2799	4967.7954
Story1	3.2	5256.8382	4971.1604
Base	0	0	0

5.1.3: STOREY SHEAR IN MODEL-III WITH SHEAR WALL

Table 5.1.3: Storey Shear (KN) in Model-III

MODEL-III			
WITH SHEAR WALL			
Maximum Storey Shear in KN			
Storey	Elevation (m)	X - Direction	Y - Direction
Story16	51.2	1173.5224	1135.0114
Story15	48	2301.2827	2225.7624
Story14	44.8	3283.6872	3175.9278
Story13	41.6	4130.7605	3995.203
Story12	38.4	4852.5272	4693.2837
Story11	35.2	5459.0116	5279.8654
Story10	32	5960.2384	5764.6436
Story9	28.8	6366.2321	6157.314
Story8	25.6	6687.0173	6467.5721
Story7	22.4	6932.6184	6705.1134
Story6	19.2	7113.0601	6879.6336
Story5	16	7238.3668	7000.8281
Story4	12.8	7318.5631	7078.3927
Story3	9.6	7363.6735	7122.0227
Story2	6.4	7383.7225	7141.4138
Story1	3.2	7388.7348	7146.2616
Base	0	0	0

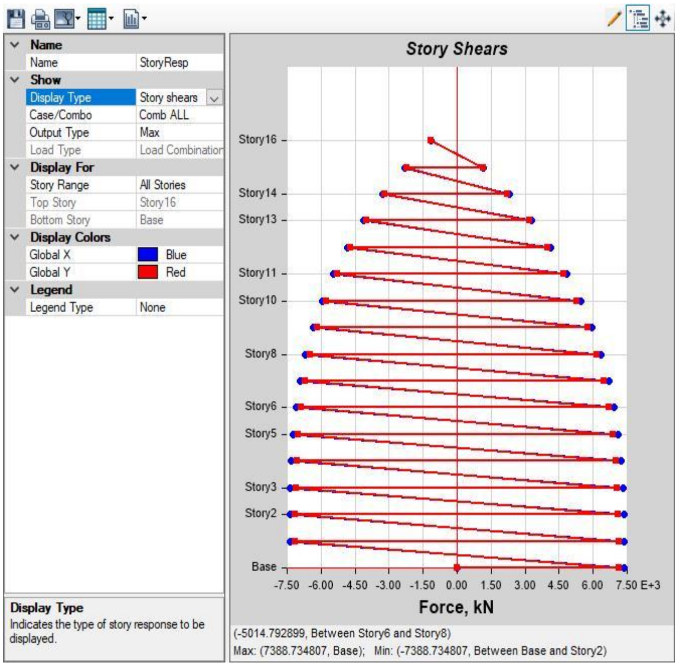


Fig 5.1.3: Storey Shear in Model-III with Shear Wall

5.1.4: STOREY SHEAR IN MODEL-IV WITH SHEAR WALL

Table 5.1.4: Storey Shear (KN) in Model-IV

MODEL-IV			
WITH SHEAR WALL			
Maximum Storey Shear in KN			
Storey	Elevation (m)	X - Direction	Y - Direction
Story16	51.2	1826.1052	1805.6416
Story15	48	3647.9283	3607.0491
Story14	44.8	5234.9386	5176.2752
Story13	41.6	6603.3302	6529.3324
Story12	38.4	7769.2969	7682.2332
Story11	35.2	8749.0329	8650.9901
Story10	32	9558.732	9451.6156
Story9	28.8	10214.5884	10100.1223
Story8	25.6	10732.7958	10612.5227
Story7	22.4	11129.5484	11004.8292
Story6	19.2	11421.0401	11293.0544
Story5	16	11623.4649	11493.2108
Story4	12.8	11753.0167	11621.3109
Story3	9.6	11825.8897	11693.3672
Story2	6.4	11858.2776	11725.3922
Story1	3.2	11866.3746	11733.3985
Base	0	0	0

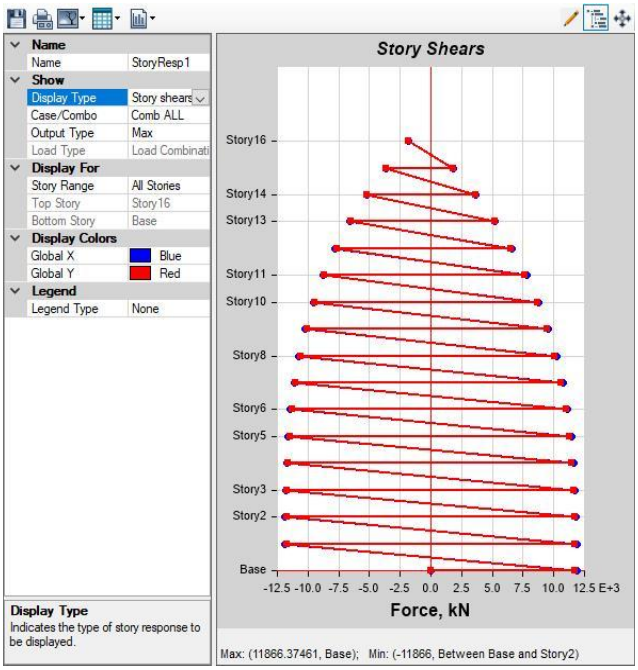


Fig 5.1.4: Storey Shear in Model-IV with Shear Wall

5.1.5: STOREY SHEAR IN MODEL-V WITH SHEAR WALL

Table 5.1.5: Storey Shear (KN) in Model-V

MODEL-V			
WITH SHEAR WALL			
Maximum Storey Shear in KN			
Storey	Elevation (m)	X - Direction	Y - Direction
Story16	51.2	1894.7458	1874.7741
Story15	48	3827.9006	3787.5524
Story14	44.8	5511.8932	5453.7948
Story13	41.6	6963.9073	6890.5038
Story12	38.4	8201.1264	8114.6819
Story11	35.2	9240.7341	9143.3316
Story10	32	10099.914	9993.4553
Story9	28.8	10795.8497	10682.0555
Story8	25.6	11345.7249	11226.1346
Story7	22.4	11766.723	11642.6952
Story6	19.2	12076.0278	11948.7397
Story5	16	12290.8228	12161.2707
Story4	12.8	12428.2915	12297.2904
Story3	9.6	12505.6177	12373.8016
Story2	6.4	12539.9849	12407.8065
Story1	3.2	12548.5767	12416.3078
Base	0	0	0

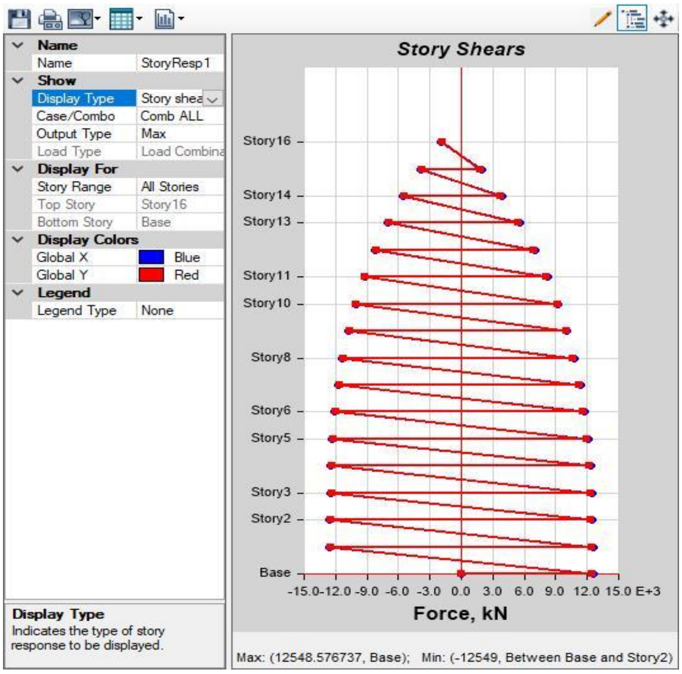


Fig 5.1.2: Storey Shear in Model-V with Shear Wall

6. CONCLUSION

It is found that the maximum storey shear in X-direction while minimum in Y direction. The maximum storey shear at base and minimum at top of the building. It is also observed that the storey shear decrease with lower storey to higher storey. It means that storey shear decrease with increase the height of the building or number of the floors of the structure. It is found that the storey shear maximum at storey first for the all models but maximum in with shear wall structure and minimum in without shear wall structure.

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