Abstract

Pushover analysis is a static, nonlinear procedure using simplified nonlinear technique to estimate seismic structural deformations. It is an incremental static analysis used to determine the force-displacement relationship, or the capacity curve, for a structure or structural element. The analysis involves applying horizontal loads, in a prescribed pattern, to the structure incrementally, i.e. pushing the structure and plotting the total applied shear force and associated lateral displacement at each increment, until the structure or collapse condition. In technique a computer model of the building is subjected to a lateral load of a certain shape (i.e., inverted triangular or uniform). The intensity of the lateral load is slowly increased and the sequence of cracks, yielding, plastic hinge formation, and failure of various structural components is recorded. Pushover analysis can provide a significant insight into the weak links in seismic performance of a structure. The performance criteria for pushover analysis are generally established as the desired state of the building given roof-top or spectral displacement amplitude. The seismic response of RC building frame in terms of performance point and the effect of earthquake forces on multi story building frame with the help of pushover analysis is carried out in this paper. In the present study a building frame is designed as per Indian standard i.e. IS 456:2000 and IS 1893:2002. The main objective of this study i s to check the kind of performance a building can give when designed as per Indian Standards. The pushover analysis of the building frame is carried out by using structural analysis and design software SAP 2000.

CHAPTER 1

1. INTRODUCTION

Pushover analysis is an approximate analysis method in which the structure is subjected to monotonically increasing lateral forces with an invariant height-wise distribution until a target displacement is reached. Pushover analysis consists of a series of sequential elastic analysis, superimposed to approximate a force-displacement curve of the overall structure. A two or three dimensional model which includes bilinear or tri-linear load-deformation diagrams of all lateral force resisting elements is first created and gravity loads are applied initially. A predefined lateral load pattern which is distributed along the building height is then applied. The lateral forces are increased until some members yield. The structural model is modified to account for the reduced stiffness of yielded members and lateral forces are again increased until additional members yield. The process is continued until a control displacement at the top of building reaches a certain level of deformation or structure becomes unstable. The roof displacement is plotted with base shear to get the global capacity curve.

Pushover analysis can be performed as force-controlled or displacement-controlled. In force-controlled pushover procedure, full load combination is applied as specified, that is, force-controlled procedure should be used when the load is known. Also, in force-controlled pushover procedure some numerical .Problems that affect the accuracy of results occur since target displacement may be associated with a very small positive or even a negative lateral stiffness because of the development of mechanisms and P-delta effects.

CHAPTER 2

2.1Literature Review

Following fundamental principles relevant to seismic ANSWERs may be adopted for most suitable home system;

(1) To behave well in an seismic weighting, home should provided simple and regular shapes, architectural plans such as T and L shapes should not be used.

(2) Plan should be symmetric whenever possible due to lack of symmetry in plan, It may lead to TWIST ANSWERs ..

(3) The foundation system should be such that it will tie together all the vertical home elements

(4) Foundation should resting on same soil if possible

(5) Lateral WEIGHT system should be such that, at every level of house, symmetry in lateral stiffness system is not disturbed

2.2Essentials of home systems for seismic resistance

All homes are design to serve gravity weight but homes are also subjected to lateral weight. All home elements will not have similar behaviour under seismic excitation ,aspects of mass distribution , home configuration ,symmetry and vertical regularity must be considered .In addition to that ,importance of stiffness ,strength and ductility in relation to acceptable ANSWER must be evaluated in home system.

2.3Stiffness and drift limitations

In design of tall home, major consideration is lateral stiffness .firstly ,deflection must be sufficiently low so that non home components can function properly like doors and elevators secondly , excessive crack should be prevented and stiffness loss should be avoided ,there should be no redistribution of weight on non home elements for example, partitions ,infill ,cladding or glazing. Third one is apartment must be sufficiently stiff to prevent dynamic motions .Dynamic motion should be such that there should be no discomfort .Drift index is a parameter that can be used to evaluate lateral stiffness .It can be defined as the ratio of max deflection at top floor of home to the home height and inner story drift index is also use getting localized excessive deformation.

Smith and caull state that the design drift range is 0.001 to 0.005, low value can be given to apartment homes, stiffness should be sufficient to controlling top deflection as per Indian standard , criteria for seismic resistant design of apartments , Is 1893(part 1) 2002,the story drift in any story due to service weight should be less than 0.004 times the story height.

2.3Types of shear wall

Coupled shear walls consist of two shear walls interconnected by beams along their height. The behaviour of coupled shear walls is mainly governed by the coupling beams. .Coupling beams are designed for ductile inelastic behaviour in order to dissipate energy .Provide damping during an seismic. The amount of energy dissipation depends on the yield moment capacity and plastic rotation of the coupling beams. .The coupling beams should be provided with an optimum level of yield Moment capacities depending on the plastic rotation capacity available Steel Detailing The plastic rotation capacity in coupling beams depends upon the type of coupling beam. Steel beam with shear-dominant coupling beam .steel beam with flexure-dominant coupling beam, R.C.C. beam with diagonal steel

CHAPTER 3

METHODOLOGY

3.1Principle for analysis of framed home with and without coupled shear wall

(1) In the seismic analysis of a framed home with coupled shear wall, only the horizontal component of seismic WEIGHT is taken into account. Vertical component of it is usually ignored. It is assumed that the seismic weight act in the longitudinal and transverse directions.

(2)A seismic WEIGHT is assumed to act at the floor slab level. Also if the distribution of mass and type of framing is in a manner that the WEIGHT acts at the mid storey height, in that case, local stress is taken into account.

(3) Rigid diaphragm action is assumed in the floor slab, in the horizontal direction. Thus, it is assumed that all the home elements in the frame in a particular storey have the same relative displacement.

(4)If irregular stiffness leads to eccentricity between the centre of stiffness and centre of gravity, then the twisting moment shall be taken into consideration.

(5) The stress analysis of a framing element is done complying to the elastic theory.

(6) Condition of the foundation should be taken into consideration.

3.2 Static and dynamic analysis

The Approach of linear analysis is viable to those apartments, which have regular geometry and are restricted to a certain height. Another name for this analysis is Equivalent Static Analysis Method. The Linear Dynamic Method is used in Time History Method and ANSWER Spectrum Method or Modal Superposition Method. Dynamic method is advancement in static method. It considers much higher modes of vibration, which can give a better understanding of actual distribution of lateral weight, within elasticity in a home frame. A noteworthy difference between linear dynamic and static analysis is the magnitude of weight and their distribution along the height of the framed home or a apartment. When the inelastic ANSWER of the apartment is taken into consideration then this approach is referred to as the Non-linear static analysis, which is a refinement in linear analysis method. It is comparatively a simple method to be implemented for the analytical studies.

In non-linear static analysis we assume, a number of static incremental horizontal weights along the height of the apartment. This method informs in a better way regarding the strength, ductility requirements and the deformation of the apartment. This allows us to recognize those members which may behave critically during seismic conditions and may reach their limit states, thus this helps us in designing and detailing of these members. Such members are therefore taken special care of in terms of strength and stability. Non-linear static analysis has many drawbacks associated with it, like it does not consider the effect of higher modes of vibrations, change in the weighting patterns and consequences of resonance. Push- over analysis which is based on non linear static analysis has gained a lot of popularity despite of various shortcomings.

The actual behaviour of the apartment under seismic could be assessed more precisely by the Non-linear dynamic method or the time history method. In this method we consider the elasto-plastic nature of the home member and the differential equations of motion are directly integrated to get the desired ANSWER of the apartment

3.3 Assumptions in seismic resistant design of framed home with shear wall

The following assumptions are made in IS-1893 (2002) for seismic (1) resistant design of apartments (Clause: 6.2, IS 1893-2002):

(1) Seismic weight cause ground motions which are impulsive in nature. These motions are uneven and quite complicated in their action. The time period and the amplitude of these weight vary continuously with time. Thus, at steady state harmonic excitations, the type of resonance obtained may not build up amplitudes of such magnitude.

(2) Seismic is not expected to occur at the same time as wind, or maximum flood conditions or maximum sea waves

(3) Elastic modulus of materials has value same as that for static analysis if an exact value is not available for use in the seismic condition.

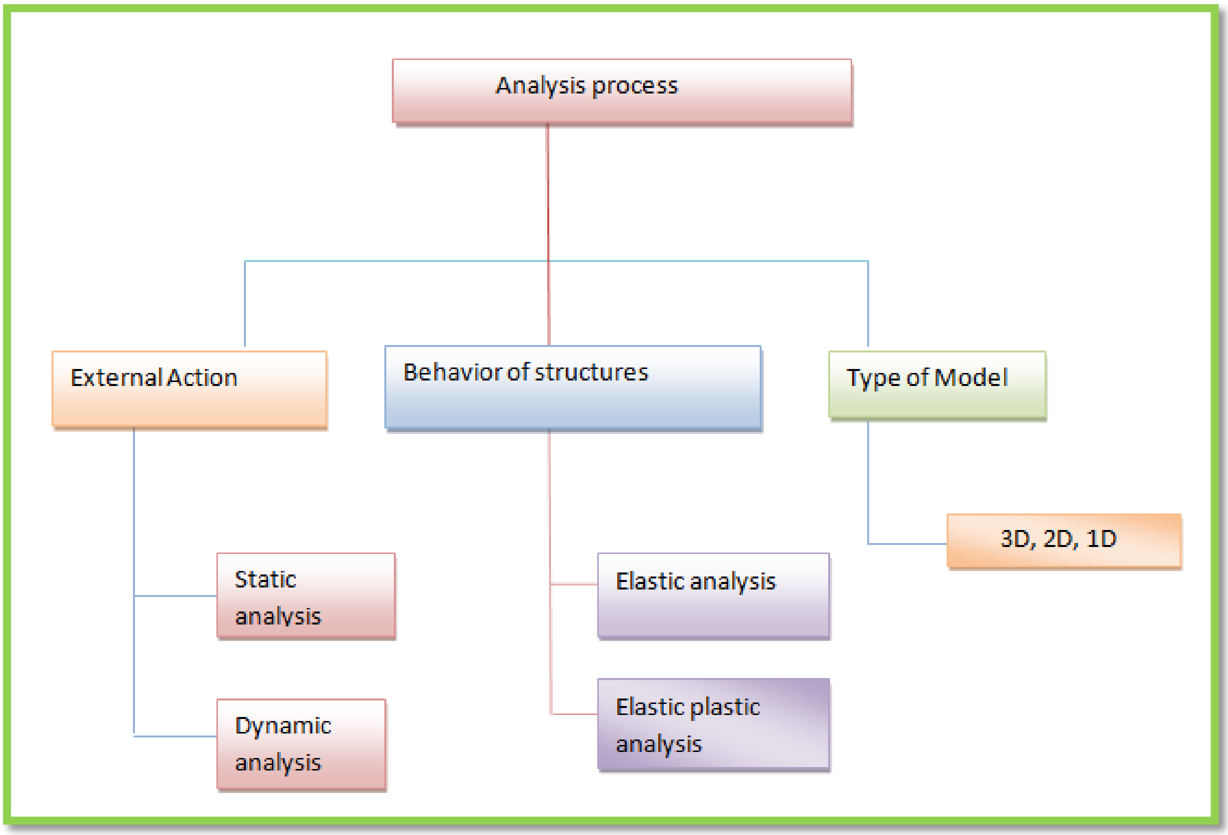


Figure 2: Method of analysis

Once the home model has been selected, it is possible to perform analysis to determine the seismically induced weight in the apartments. The procedure of analysis depends on three factors:

(1) Applied weights.

(2) The behaviour of apartment or home materials.

(3) Type of home model selected

3.4 Code based procedure for seismic analysis

Dominant characteristics of method of analysis of seismic resistant homes as mentioned in Indian Standard, 1893 (part I): 2002 are discussed below.

In the ANSWER Spectrum Analysis, the following procedure is adopted-

1. The design spectrum is chosen.
2. Inclusion of modes of vibration, which are to be used in the seismic analysis.
3. For the respective mode, the ANSWER of the spectrum is observed.
4. Calculation of modal participation factor with respect to SDOF read from the curve.
5. The total ANSWER is obtained by the combination of all the modes.
6. Highest obtained ANSWER is converted into moments and shear weight. The peak storey shear acting in mode k, with storey height (i), is given by following relation.

$$S_i = A_{k*} \theta_{ik*} P_{k*} W_i$$

Where,

A_k = Design horizontal spectrum value.

Θ_{ik} = Mode shape coefficient.

P_k = Modal participation factor.

W_i = Seismic weight at the $_i$th storey.

$$P_k = \frac{\sum_{i=1}^{n} W_i \ \theta_{ik}}{\sum_{i=1}^{n} Wi \ \theta_{ik}^2}$$

The SRSS combination is used to obtain the peak storey shear in i^{th} storey .The consideration of all modes for lateral weight at each storey is given by the following equation-

$F_{roof} = V_{roof}$

$F_i = V_i - V_{i+1}$

The peak ANSWER of the apartment is calculated CQC is as following-

Complete Quadratic Combination (CQC) method-

$\lambda = \sqrt{(\sum\sum\lambda_i \ P_i \ \lambda_j)}$

Where,

λ_i = ANSWER quantity in mode j,

P_i = cross modal coefficient,

λ_i = ANSWER quantity in mode j.

CHAPTER 4

4.1 Modelling with E -Tab

This work presents the analysis of a framed home (G+9) for varying cases of coupled shear wall locations, using E-Tab. This research work is an approach, to study the effect this lateral weight on the ANSWER of a 3-D framed home, when it is subjected to seismic weight. The analysis method used in E-Tab, is the ANSWER Spectrum Method conforming to IS 1893:2002. E-TAB is equipped with advanced finite element method and dynamic analysis capabilities. It features rapid analysis, and visualization tools.

A G+9 storey home $[3\ D\ Frame]$ with different types of arrangement of coupled shear wall was designed for all possible weight combinations (i.e live weight, dead weight, seismics weights). E-Tab is user friendly and allows us to easily draw a frame, assign dimensions and thus input geometrical properties of all components along with definition of weights. Then as per the assigned specifications, we analyze the RCC frames with and without coupled shear wall.

The model of framed test home, consists of 3 bays along x-axis(18 m),3bays along z-axis@ 6m.The y- axis comprises of G+9 stories. The height of each floor is 3. The weights to which the apartment was subjected were, Dead weight, Live weight and Seismic weights, which had their calculation basis same as mentioned in IS 875 (Part 1): 1987 and IS1893 (Part 1): 2002 . The dimensions were assigned to the columns and the beams along with the material specification. The supports at the base of the home are fixed and the code of practice, for the analysis in E-tab is defined.

Thereafter, the program is run for analysis. It is the post processing mode by which, the deflection of the members is studied, taking into account a suitable weight combination. The value of generated internal weight along with the BMDs and SFDs could also be designed.

4.2Weight type

4.2.1 Dead Weight

The dead weight comprises of weight due to all home components of a apartment in other words these are the permanent parts of the construction work or rather remain always with the apartment. The dead consists of self weight of all home components like floor, walls, beams, columns, roof etc. also floor finishes, false ceilings, false doors and other permanent constructions in the apartment. The unit weight of RCC and Plain concrete made with sand and gravel or crushed natural aggregate are 25 KN/mm^2 and 24 KN/mm^2 respectively as per IS 875.

4.2.2 Imposed Weight

Imposed weights are the movable weights or the live weights within a home. They are not permanent construction of a apartment. It includes weight of furniture, mobile partitions, vibratory effects, impact weights, point weights and uniform weights.

4.2.3 Seismic Weight

Design Lateral WEIGHT: The lateral seismic WEIGHT is evaluated for the home as a whole. This WEIGHT shall then be used for the design of the entire apartment. The floor diaphragm action further decides its distribution to horizontal weight resisting components. Design Seismic Base Shear: The summation of all design lateral seismic weight at the base of the home is referred to as the Design Seismic Base Shear (V_B). The expression for this WEIGHT as given in IS 1893(Part 1) : 2002, clause no. 7.5.3 is :

$$V_B = A_h W$$

Where,

A_h = Design horizontal acceleration spectrum, using the fundamental natural period T_a , in the direction under consideration.

W = Seismic Weight of the Home.

4.2.4 Fundamental Natural Period

It is the time period with long modal vibration period. The fundamental natural period of vibration (T_a), in seconds of a moment resisting frame home without brick infill is given as:

$T_a = 0.075\ h^{0.75}$ for RCC frame home

$= 0.085\ h^{0.75}$ for steel frame home

Where,

h = height of the home which does not include the basement walls connected to columns of the home or to the ground floor deck. The inclusion of the basement storeys is when they are not connected this way.

In case of moment resisting frame with brick infill, the evaluation of the fundamental period is done by the following empirical formula given in the IS code:

$$T_a = 0.09 \frac{h}{\sqrt{d}}$$

Where,

h = height of the home in mm

d = base dimension of the home at the plinth level, in the direction of considered horizontal seismic WEIGHT.

4.2.5 Distribution of Design WEIGHT

The distribution of base shear at different heights of the home is given by the following expression, as per IS 1893:2002.

$$Q_i = V_B \frac{W_i h_i^2}{\sum W_{j\,H_j^2}}$$

Where,

Q_i = Design lateral WEIGHT at i^{th} floor,

W_i = Seismic weight of i^{th} floor,

h_i = i^{th} floor height from the base,and

n = no. of storeys in the home, where the weights are positioned.

4.2.6 Dynamic Analysis

Dynamic Analysis is carried out to evaluate the seismic WEIGHT which is to be used for design and is to be distributed at different floors of the home and also to the other components that resist the horizontal WEIGHT. The homes for dynamic analysis are:

a) Regular Homes: Frame homes exceeding the height of 40 m in seismic Zones IV and V and the ones in Zones II and III with height greater than 90 m.

b) Irregular Homes: Frame home in Zones IV and V with height greater than 12 m and with height more than 40 m Zones II and III.

If there lies irregularities in the design of a home then the analytical model thus framed for the prototype shall represent it accurately. Homes that are not regular in plan cannot be designed for dynamic analysis. Dynamic method for frame homes can be carried out by ANSWER Spectrum Method or Time History Method.

4.3 Analytical study of G+9 framed home with and without coupled shear

In the present study a G+9 Storey framed home has been analysed and four different cases of the home are prepared, each case with different arrangement of shear wall. Thus, the effect of location of shear wall on the dynamic ANSWER of the framed home is studied, to draw a suitable conclusion. Figure shows the plan of the home under study. The following screen shots have been taken from E -Tab.

4.3.1 Characteristics of the Framed Home

Length = 18 m (3 bays along x-axis)

Width = 18 m (3 bays along z-axis @6m)

Height =90 m (height of each story is 3 m).

Slab thickness =0.15m

Wall thickness =0.2m

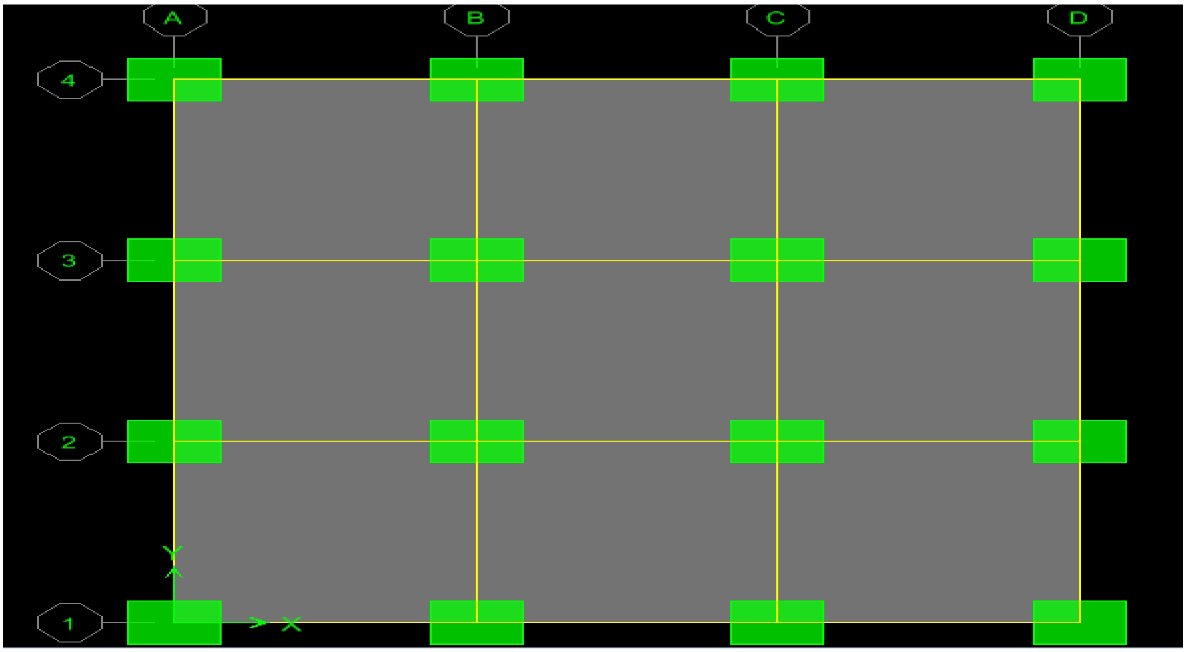


Figure 3: Plan of a G+9 storey framed home.(18m*18m)

4.3.2 Defining Sectional Properties

Member property is allocated in order to define the type of section of the members of the home and also the material type which is to be assigned to the member. Member property could be generated in E-Tab. by using the sub tab “property” in the window of the program. The section of beams and columns has already been discussed in previous section. Prismatic beams and columns have been used.

BEAMS: 0.3 m× 0.50 m (prismatic)

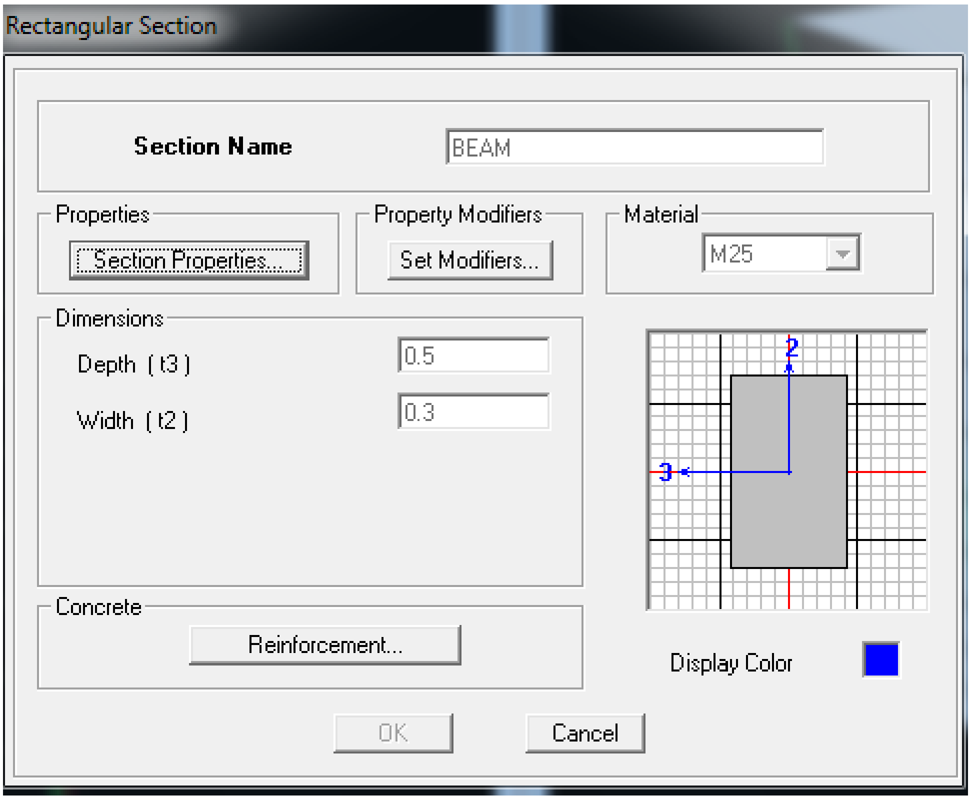


Figure 4

COLUMNS: .30 m × .4 m

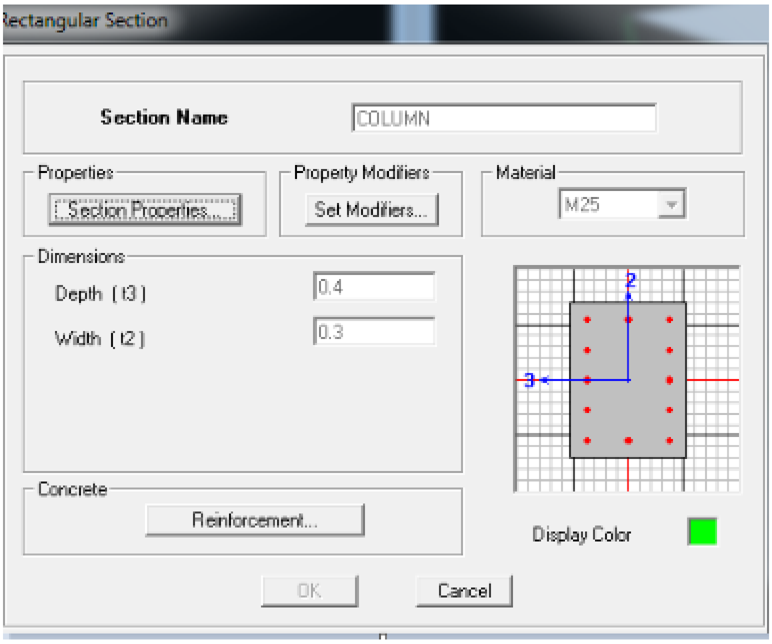
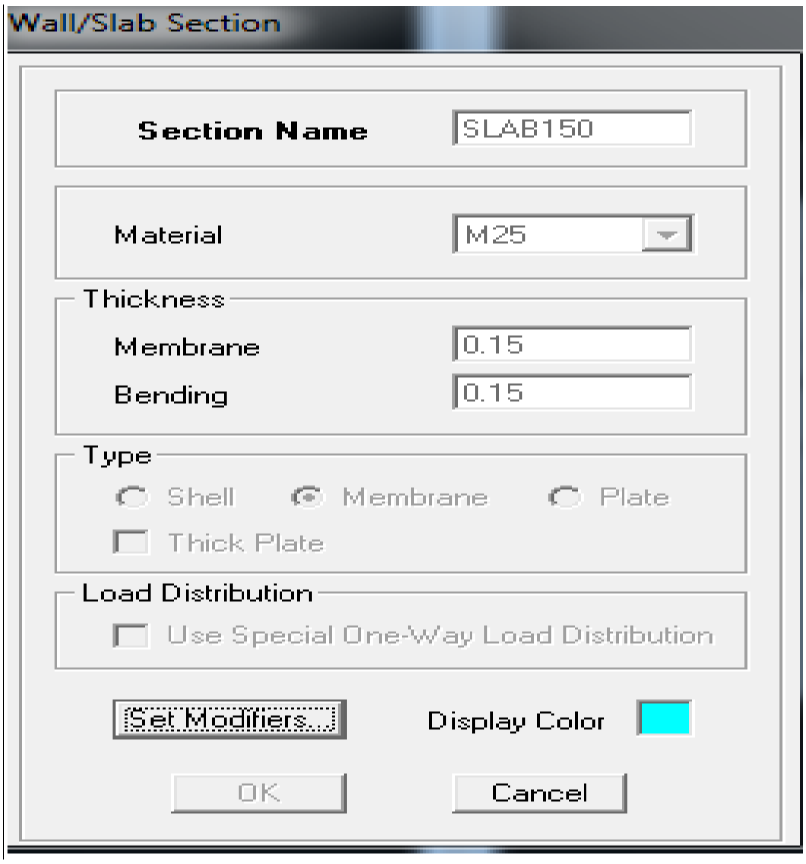


Figure 5

Slab and wall thickness:



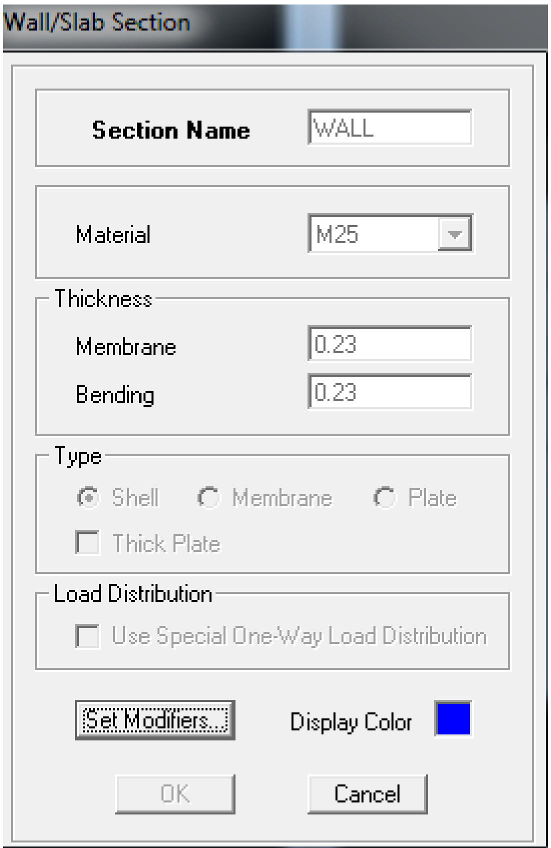


Figure 6 and figure 7

Material properties: concrete M30 Grade, bending steel F_y500, shear steel F_y 415

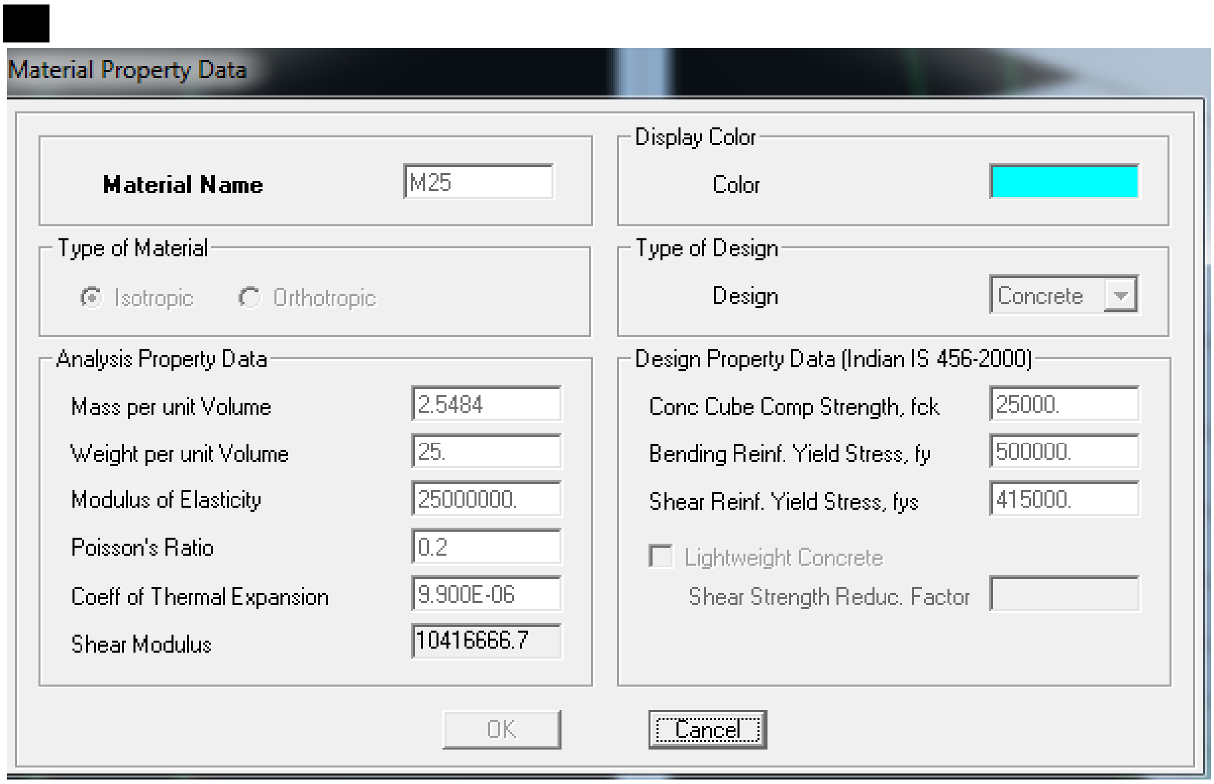


figure 8

4.3.3 Assigning Supports

The base of the home is provided with a fixed support. This fixed support is assigned to the home.

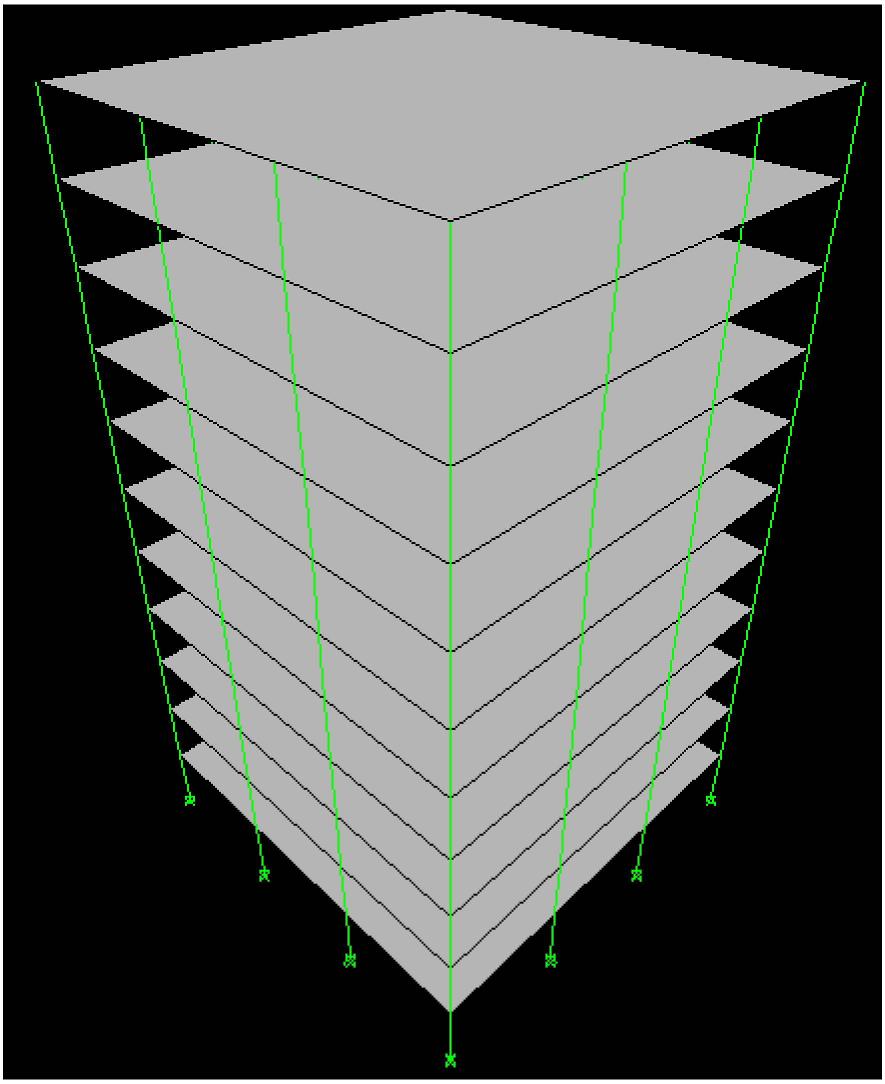


Figure 9: Fixed supports at the base.

4.3.4 Specification of the Type of Material

The types of material used for the apartment or the home components are specified, along with the values of constants as per the Indian Standard Code.

4.3.5 Generation of Weights

Weights are assigned to the apartment and its members by using the weight generator in E-Tab. In E-Tab the categories of weight are defined. The types of weights which has been used in analysis are as following-

a. Dead weight.
b. Live weight.
c. slab weight.
d. Wall weight
e. Seismic Weight

Weight cases:

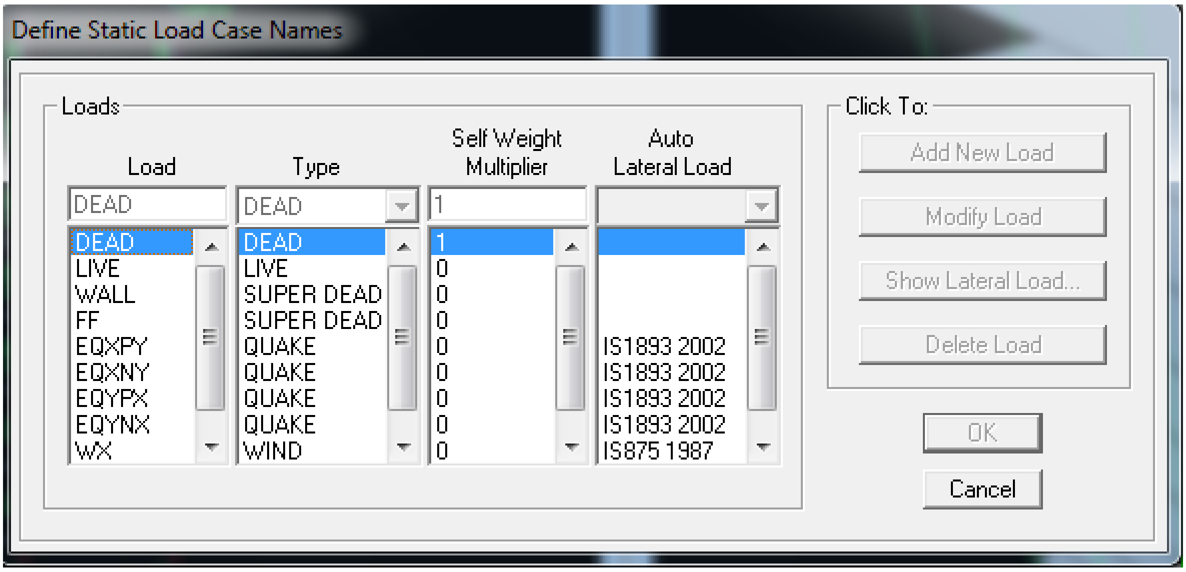


Figure10

4.3.6 Dead weight

It may include the floor weight or member weight. The dead weight comprises of weight due to all home components of a apartment. The home has been subjected to various intensities of floor weights, which have different range of actions.

4.3.7 Live Weight:

The live weight applied on the framed home is of different intensities. Live weight on roof is 3 kN/m . Floor finishing weight 1.5 KN/m^2.

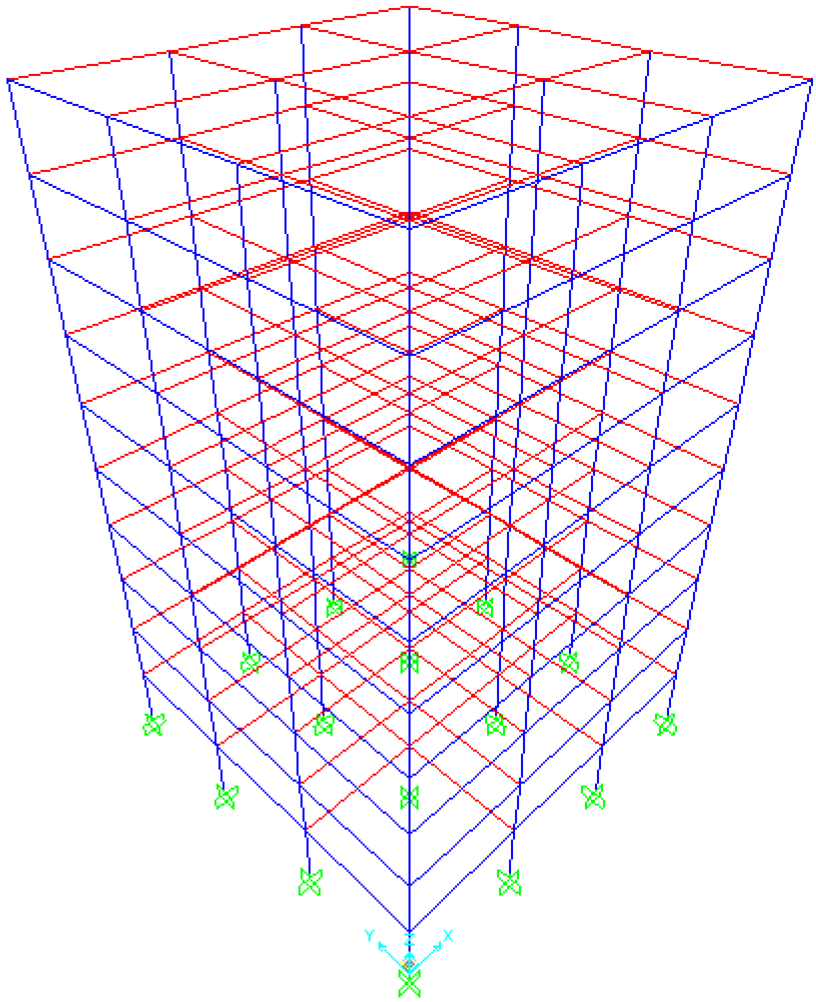


Figure 11: Dead weight as floor weight and member weight on the apartment.

4.3.8 Slab weight

Self weight is generated by the software itself by defining the primary weight case as the slab weight in the “weight & definition” tab.

4.3.9 Wall Weight

Weighting due to wall is distributed to the members It is taken by software it self.

4.3.10 Seismic Weight

The seismic weight are calculated following the guidelines, mentioned in IS 1893(Part I):2002. The software can generate seismic WEIGHT provided that, the code which is to be followed, is defined. The lateral seismic weight are generated in the two horizontal directions i.e. X and Z directions. The Base Shear calculated by the E-Tab is as per the IS code:

$$V_B = A_h W$$

Where,

A_h = Design horizontal acceleration spectrum, using the fundamental natural period T_a, in the direction.

W = Seismic Weight of the Home.

4.3.11 Weight Combination

The analysis of the apartment proceeds with the consideration of the weight combinations. The various weights like the dead weight, live weight, wall weights, seismic weights etc. are considered in a proper proportion and thus the apartment is designed using the weight cases which are the combinations of these.

Weight combination data:

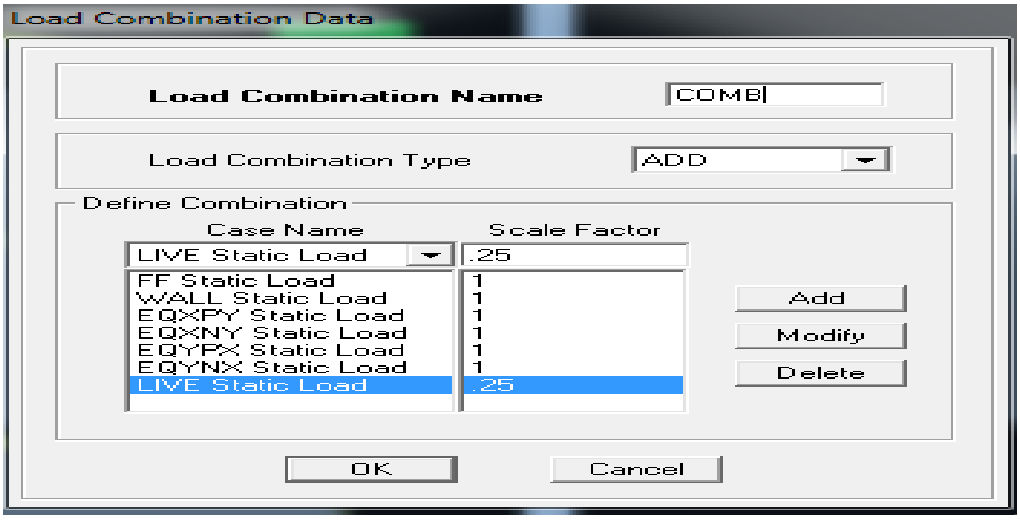


Figure12: Primary weight combinations

Reduction factor for weights:

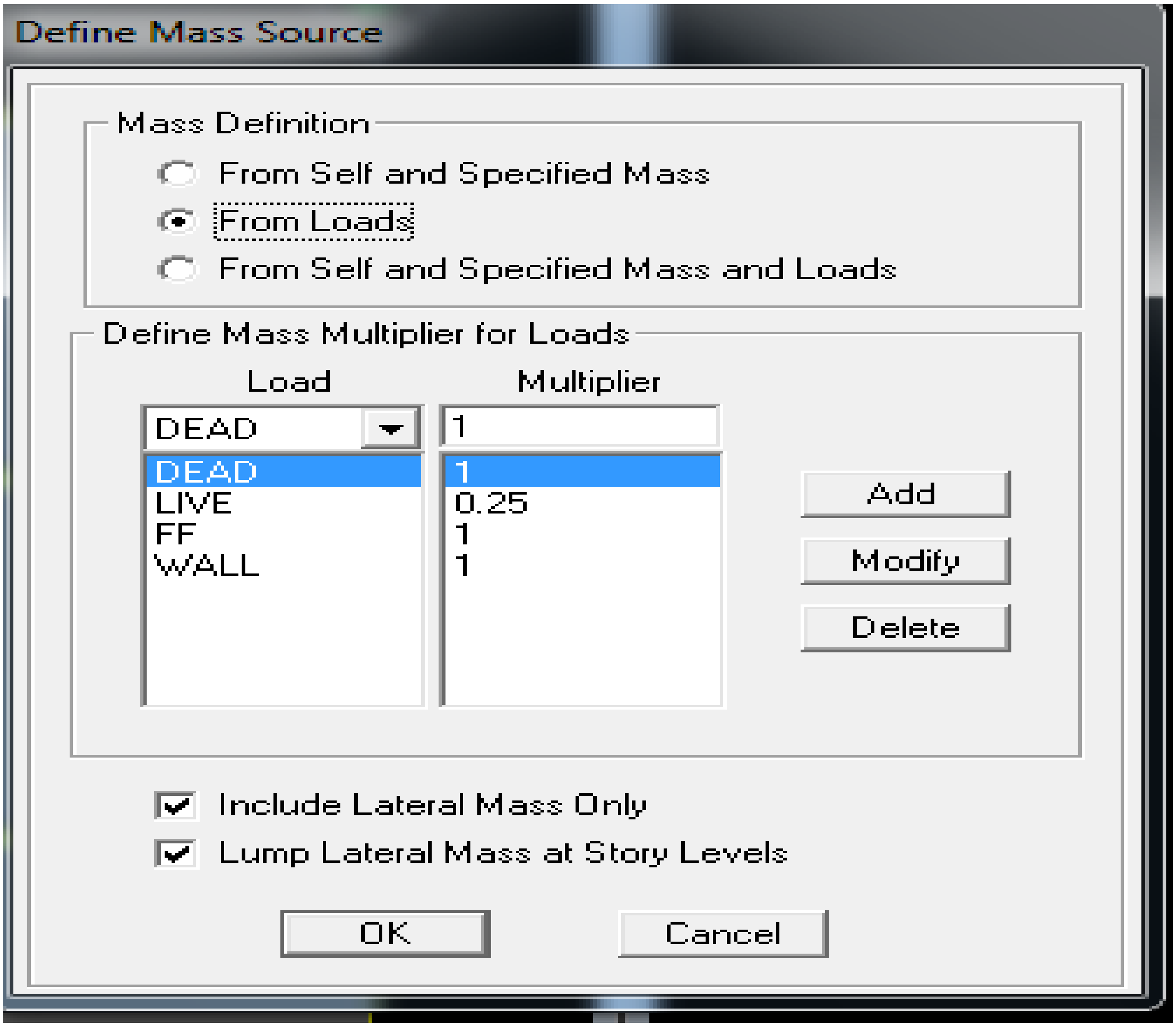

Define Mass Source
Mass Definition
From Self and Specified Mass
From Loads
From Self and Specified Mass and Loads
Define Mass Multiplier for Loads
Load
Multiplier
DEAD
1
DEAD
LIVE
FF
WALL
1
0.25
1
1
Add
Modify
Delete
Include Lateral Mass Only
Lump Lateral Mass at Story Levels
OK
Cancel

Figure 13

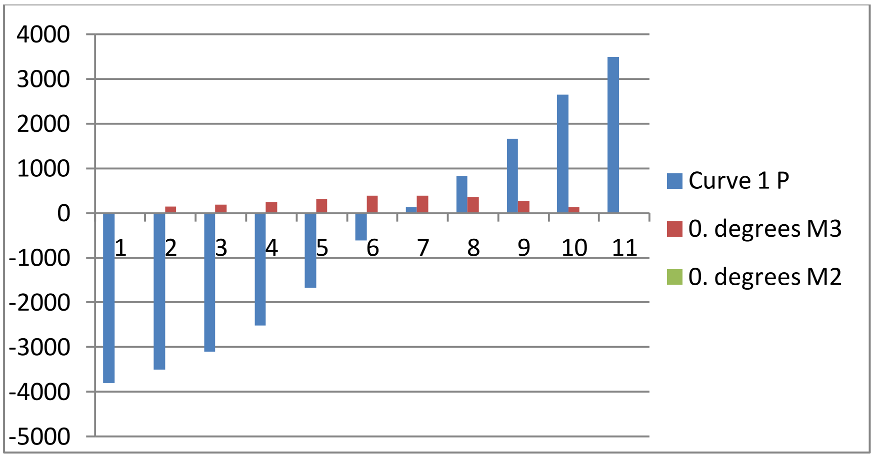
5.1 Results

4. RESULTS

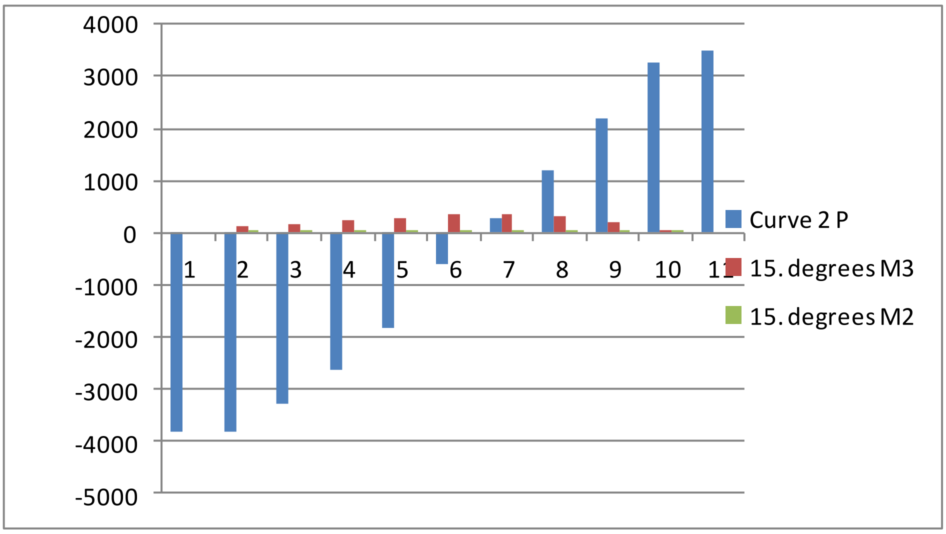
On the above building frame the non linear static pushover analysis is performed to investigate the performance point of the building frame in terms of base shear and displacement. For pushover analysis the various pushover cases are considered such as push gravity, push X (i.e. loads are applied in X direction), push Y (i.e. loads are applied in Y direction). The various load combinations are also used for this purpose. After pushover analysis the demand curve and capacity curves are obtained to get the performance point of the structure. The performance point is obtained as per ATC 40 capacity spectrum method. The base shear for PUSH X load case is (904.612 KN). And for PUSH Y base shear at performance point is (915.197) as shown in figure

Column intraction curves and tables:

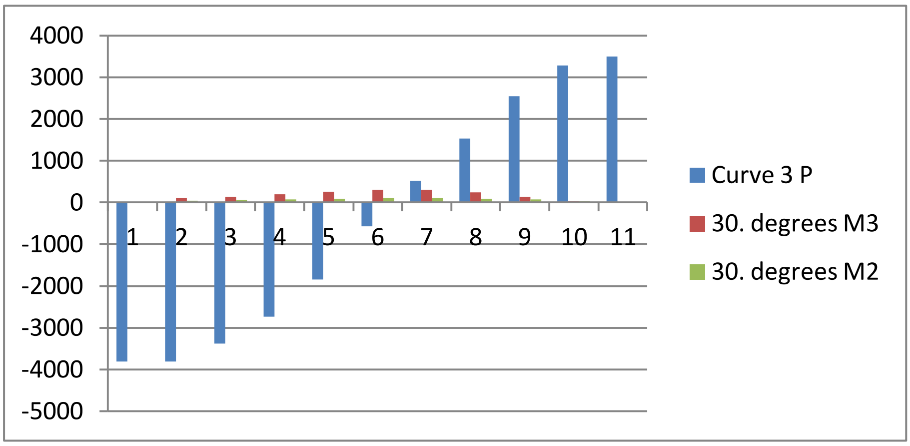
Curve 1	0. degrees	
P	M3	M2
-3810.3	0	0
-3511.06	147.9328	0
-3099.22	195.128	0
-2517.27	250.8787	0
-1674.35	314.8028	0
-612.957	382.123	0
127.0696	386.7478	0
834.2274	361.1915	0
1662.192	275.0303	0
2655.853	132.1866	0
3492.041	0	0



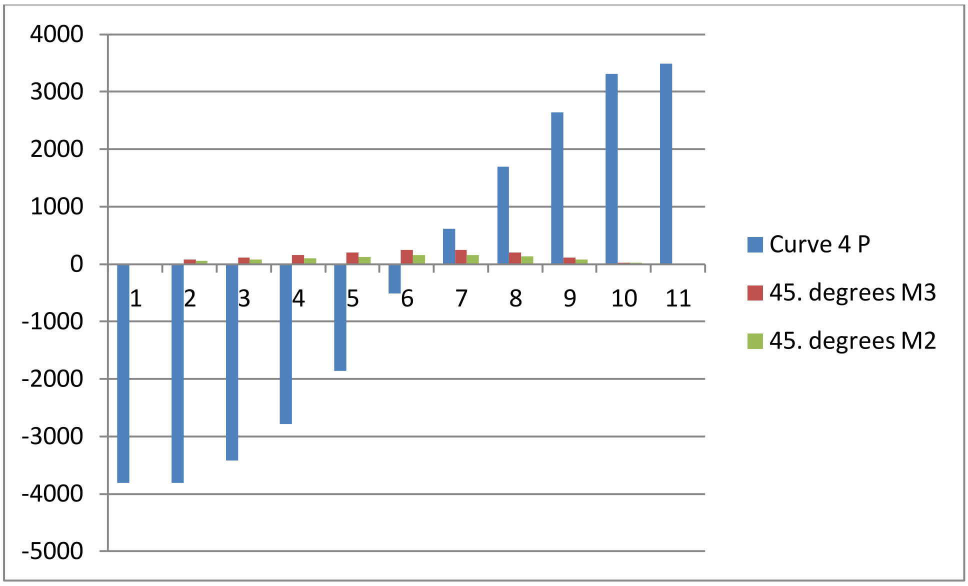
Curve 2	15. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	117.4401	21.5068
-3263.16	167.8358	26.8775
-2645.34	224.1198	33.7359
-1811.12	286.5337	40.7831
-604.55	354.7683	50.3025
298.0932	353.4224	50.6083
1208.793	301.5445	52.476
2191.1	194.1542	45.665
3249.103	38.5784	25.1397
3492.041	0	0



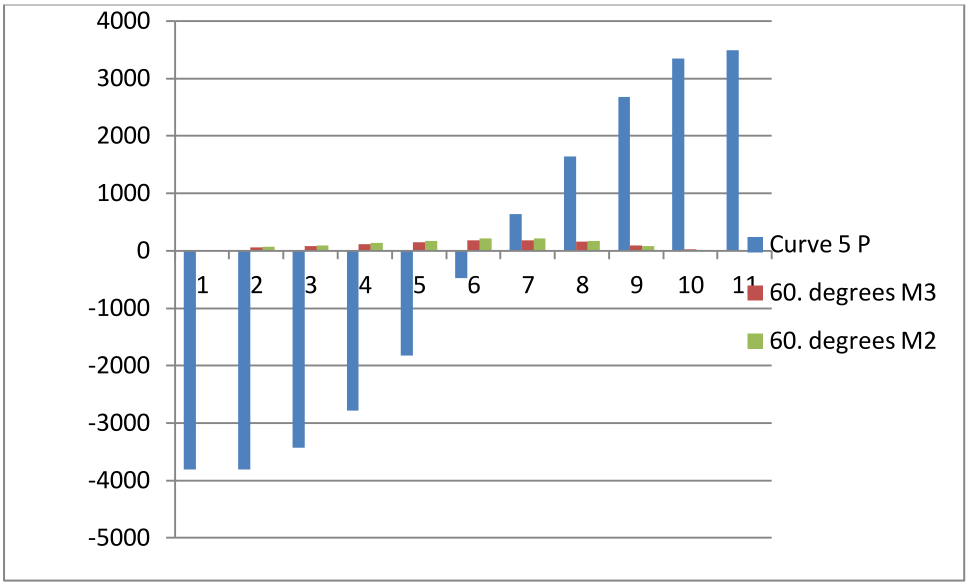
Curve 3	30. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	99.3414	36.8919
-3384.4	141.047	51.1633
-2740	194.043	65.8957
-1846	251.394	82.8778
-566.68	304.501	102.069
515.542	307.873	101.008
1531.83	247.027	95.5849
2548.06	134.352	73.5455
3287.81	32.1687	21.6891
3492.04	0	0



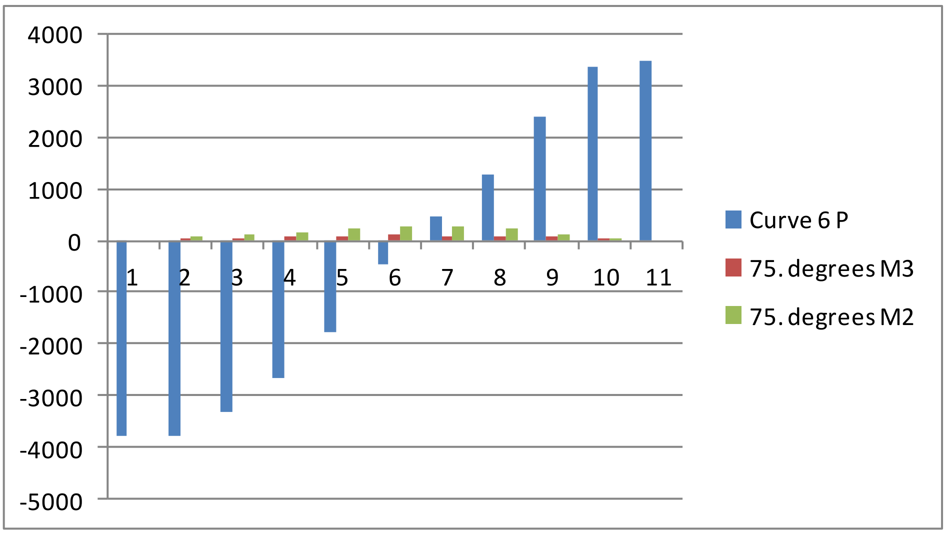
Curve 4	45. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	81.1813	52.9308
-3425.61	114.1201	74.7396
-2788.53	158.0658	99.6959
-1855.68	207.3965	126.858
-513.94	249.5861	154.9376
615.5763	246.8412	158.9419
1690.337	200.926	130.4128
2647.731	115.0349	76.639
3316.568	27.5675	18.7938
3492.041	0	0



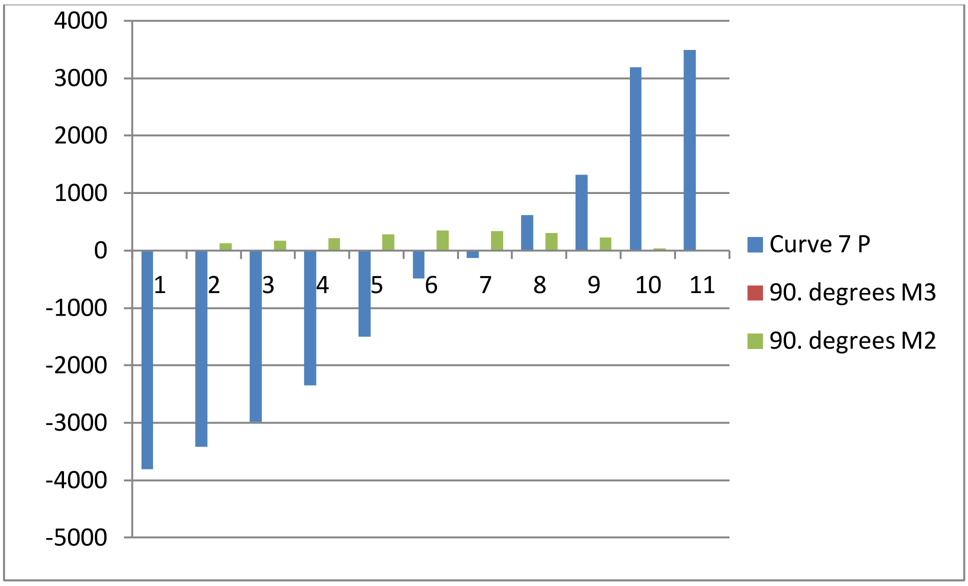
Curve 5	60. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	59.7368	71.5918
-3424.97	86.1574	98.111
-2786.26	117.4013	134.0994
-1824.96	149.7527	174.5037
-471.643	184.4768	212.721
638.9825	182.0104	214.7496
1645.874	157.0087	167.1303
2676.669	97.7512	86.2232
3344.638	23.1146	15.9504
3492.041	0	0



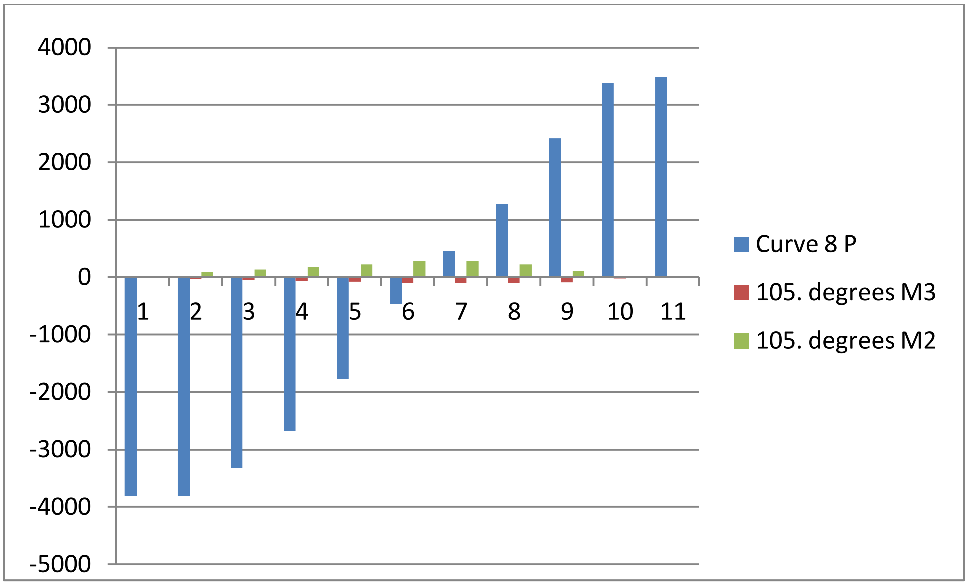
Curve 6	75. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	36.5504	91.4335
-3320.87	49.1761	129.1021
-2676.62	62.649	176.3359
-1772.67	80.6622	226.6884
-463.69	103.3424	281.1802
455.6915	95.0449	279.7358
1270.447	95.9407	219.7757
2413.218	93.779	114.6648
3375.416	18.0684	12.9671
3492.041	0	0



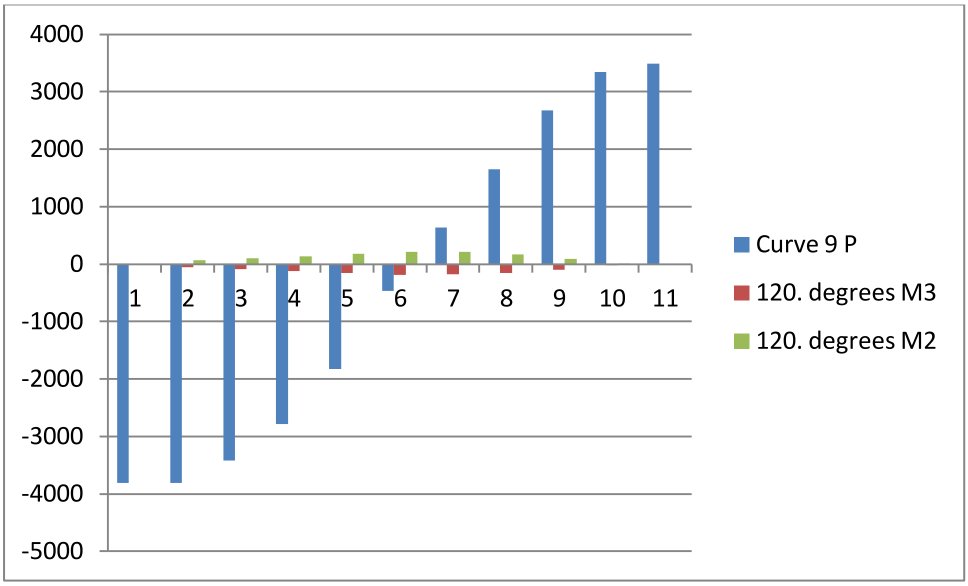
Curve 7	90. degrees	
P	M3	M2
-3810.3	0	0
-3416.06	0	126.0205
-2978.64	0	165.3185
-2343.66	0	215.5833
-1495.76	0	278.5432
-487.699	0	346.6093
-129.472	0	341.0493
612.6906	0	302.9814
1320.9	0	230.8886
3196.06	0	34.421
3492.041	0	0



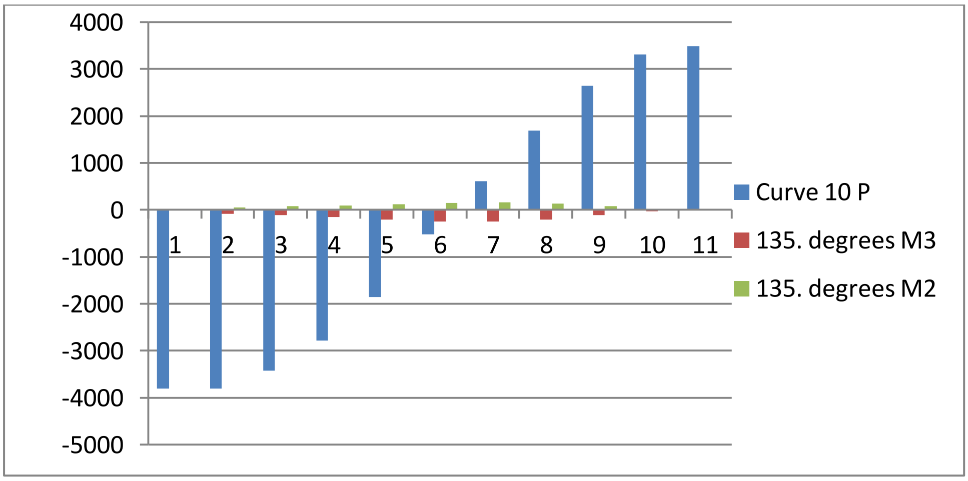
Curve 8	105. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-36.5504	91.4335
-3320.87	-49.1761	129.1021
-2676.62	-62.649	176.3359
-1772.67	-80.6622	226.6884
-463.69	-103.342	281.1802
455.6915	-95.0449	279.7358
1270.447	-95.9407	219.7757
2413.218	-93.779	114.6648
3375.416	-18.0684	12.9671
3492.041	0	0



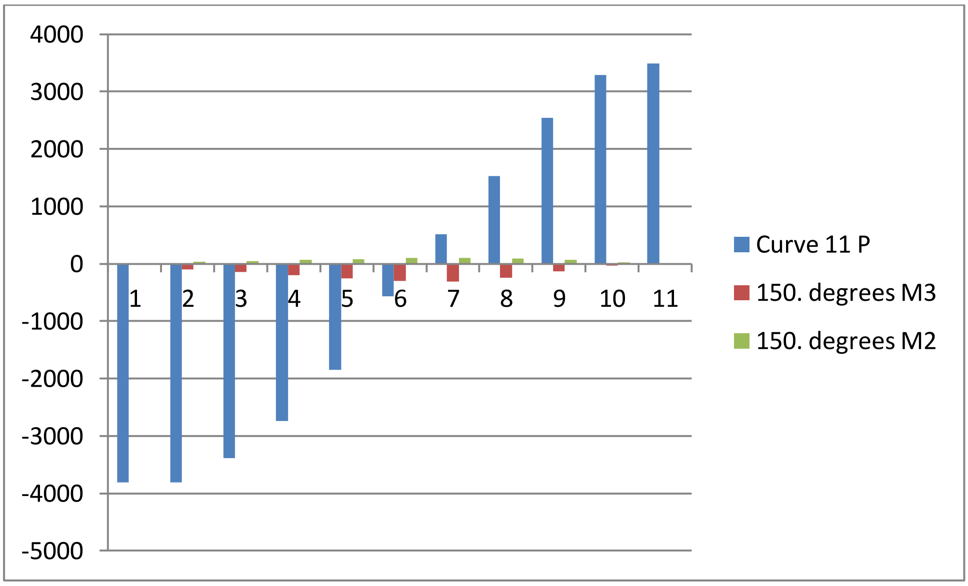
Curve 9	120. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-59.7368	71.5918
-3424.97	-86.1574	98.111
-2786.26	-117.401	134.0994
-1824.96	-149.753	174.5037
-471.643	-184.477	212.721
638.9825	-182.01	214.7496
1645.874	-157.009	167.1303
2676.669	-97.7512	86.2232
3344.638	-23.1146	15.9504
3492.041	0	0



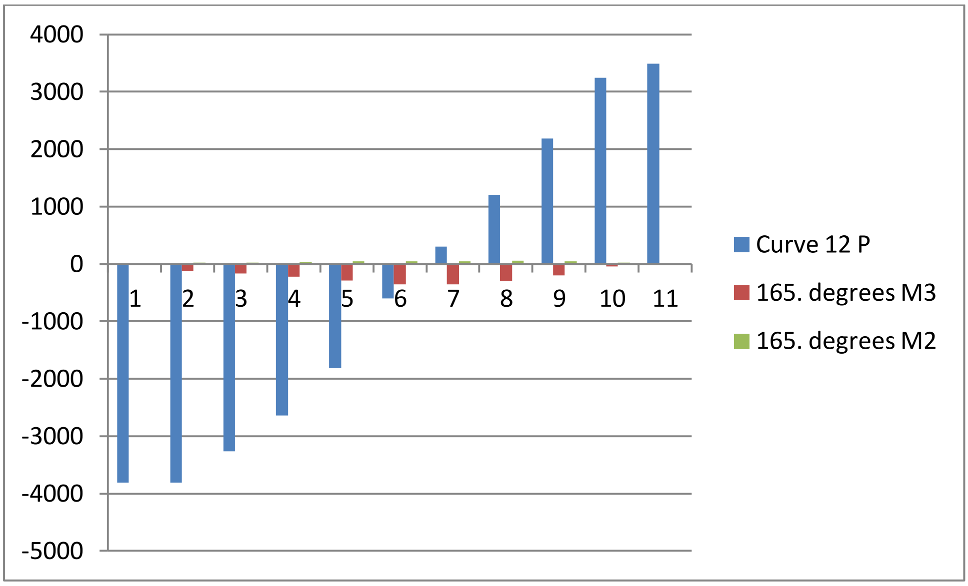
Curve 10	135. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-81.1813	52.9308
-3425.61	-114.12	74.7396
-2788.53	-158.066	99.6959
-1855.68	-207.397	126.858
-513.94	-249.586	154.9376
615.5763	-246.841	158.9419
1690.337	-200.926	130.4128
2647.731	-115.035	76.639
3316.568	-27.5675	18.7938
3492.041	0	0



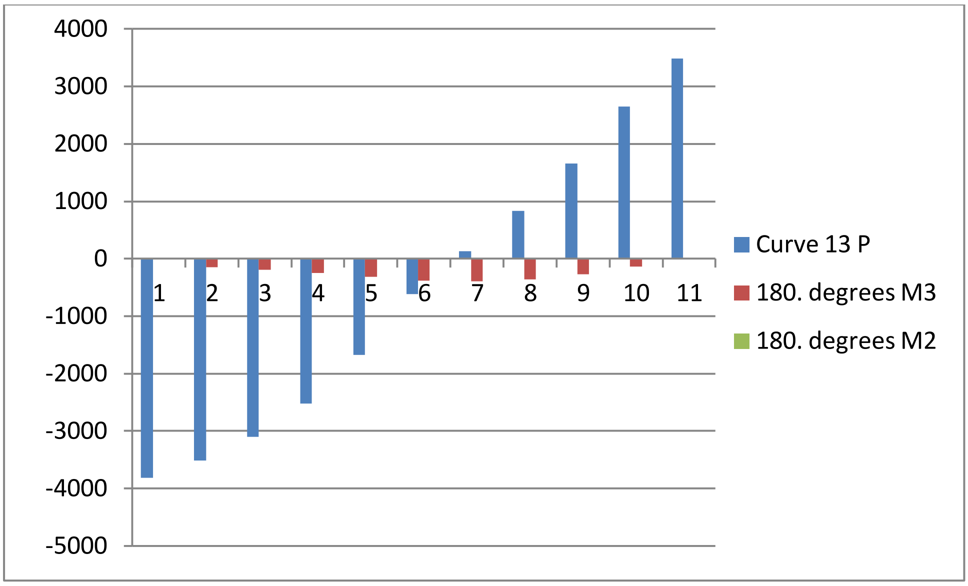
Curve 11	150. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-99.3414	36.8919
-3384.43	-141.047	51.1633
-2740.04	-194.043	65.8957
-1846.04	-251.394	82.8778
-566.681	-304.501	102.0691
515.5423	-307.873	101.0081
1531.831	-247.027	95.5849
2548.06	-134.352	73.5455
3287.813	-32.1687	21.6891
3492.041	0	0



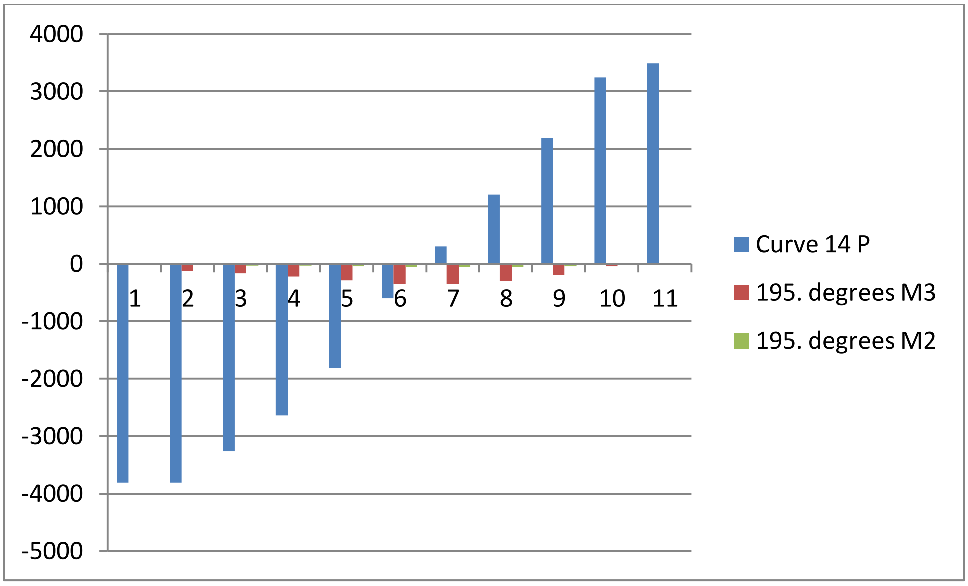
Curve 12	165. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-117.44	21.5068
-3263.16	-167.836	26.8775
-2645.34	-224.12	33.7359
-1811.12	-286.534	40.7831
-604.55	-354.768	50.3025
298.0932	-353.422	50.6083
1208.793	-301.545	52.476
2191.1	-194.154	45.665
3249.103	-38.5784	25.1397
3492.041	0	0



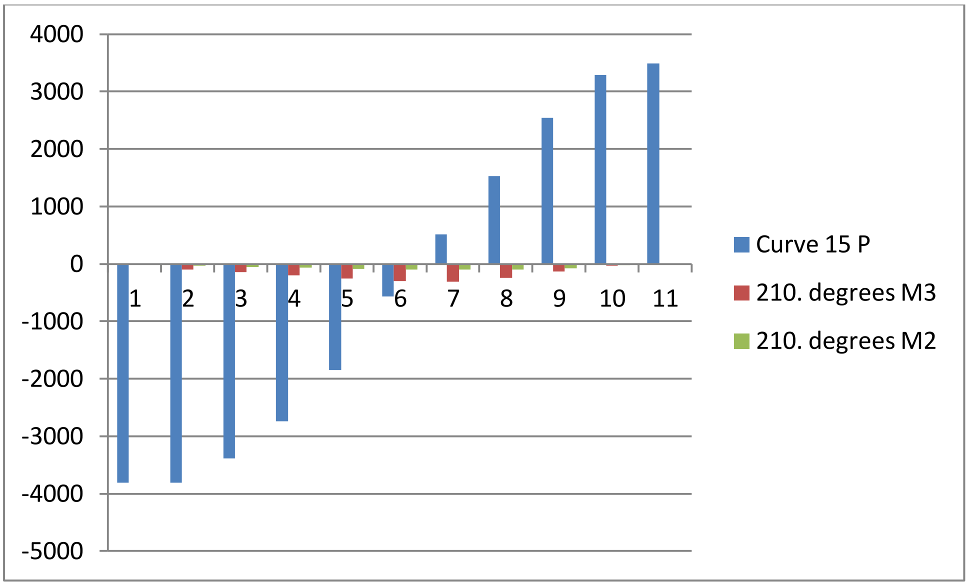
Curve 13	180. degrees	
P	M3	M2
-3810.3	0	0
-3511.06	-147.933	0
-3099.22	-195.128	0
-2517.27	-250.879	0
-1674.35	-314.803	0
-612.957	-382.123	0
127.0696	-386.748	0
834.2274	-361.192	0
1662.192	-275.03	0
2655.853	-132.187	0
3492.041	0	0



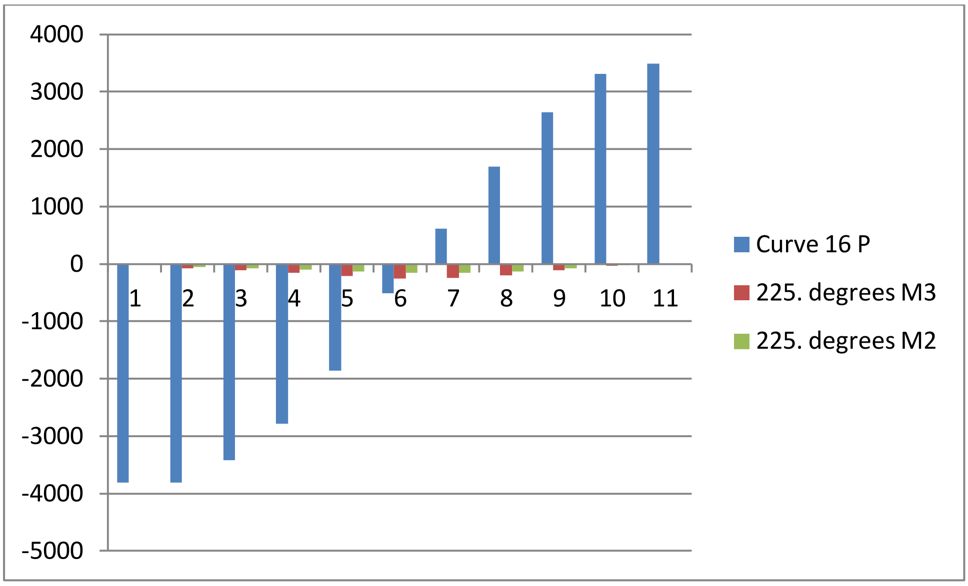
Curve 14	195. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-117.44	-21.5068
-3263.16	-167.836	-26.8775
-2645.34	-224.12	-33.7359
-1811.12	-286.534	-40.7831
-604.55	-354.768	-50.3025
298.0932	-353.422	-50.6083
1208.793	-301.545	-52.476
2191.1	-194.154	-45.665
3249.103	-38.5784	-25.1397
3492.041	0	0



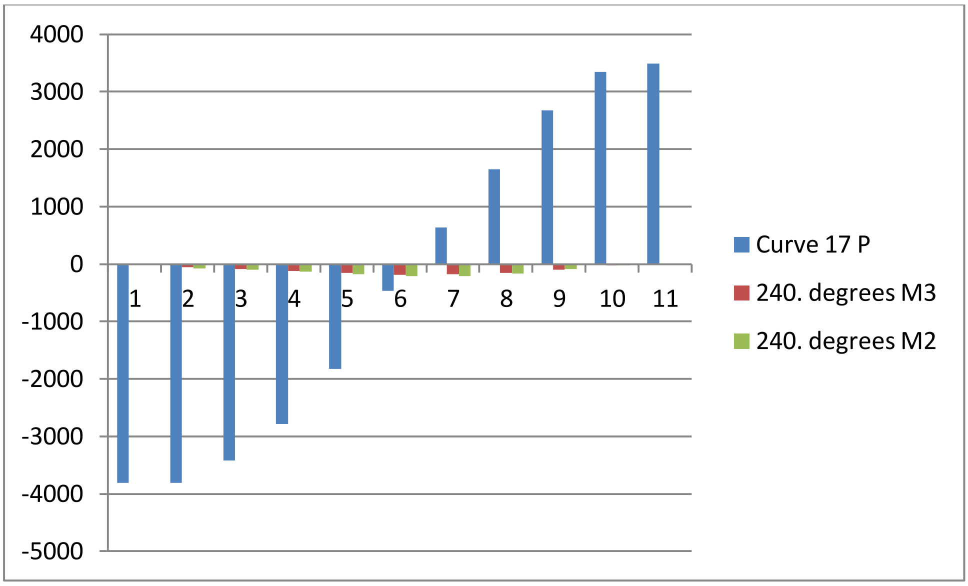
Curve 15	210. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-99.3414	-36.8919
-3384.43	-141.047	-51.1633
-2740.04	-194.043	-65.8957
-1846.04	-251.394	-82.8778
-566.681	-304.501	-102.069
515.5423	-307.873	-101.008
1531.831	-247.027	-95.5849
2548.06	-134.352	-73.5455
3287.813	-32.1687	-21.6891
3492.041	0	0

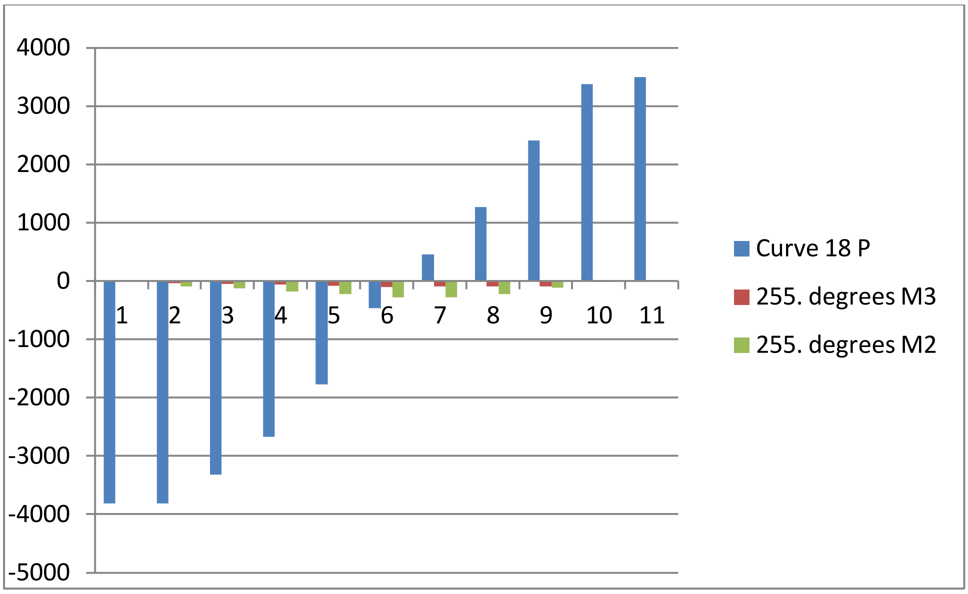


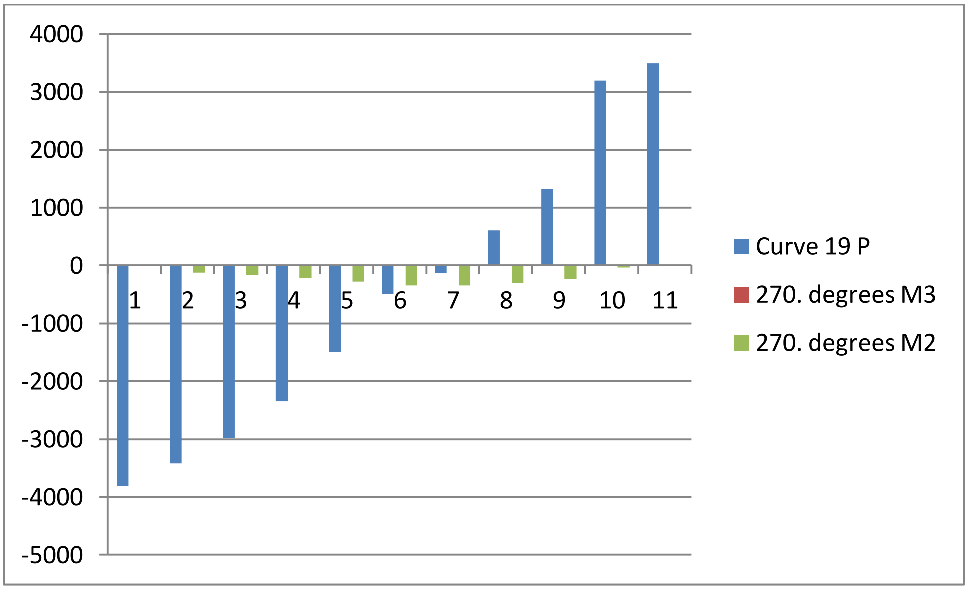
Curve 16	225. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-81.1813	-52.9308
-3425.61	-114.12	-74.7396
-2788.53	-158.066	-99.6959
-1855.68	-207.397	-126.858
-513.94	-249.586	-154.938
615.5763	-246.841	-158.942
1690.337	-200.926	-130.413
2647.731	-115.035	-76.639
3316.568	-27.5675	-18.7938
3492.041	0	0



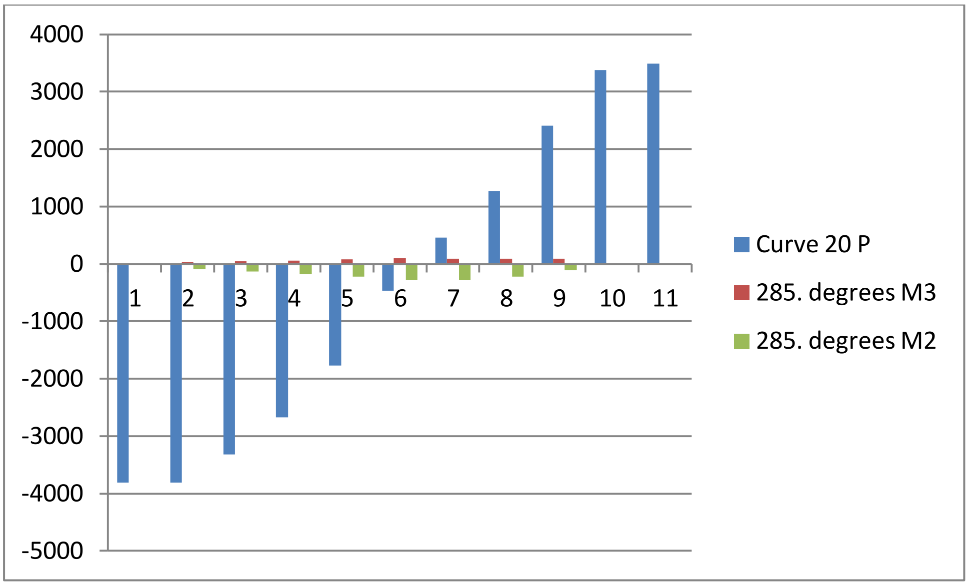
Curve 17	240. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	-59.7368	-71.5918
-3424.97	-86.1574	-98.111
-2786.26	-117.401	-134.099
-1824.96	-149.753	-174.504
-471.643	-184.477	-212.721
638.9825	-182.01	-214.75
1645.874	-157.009	-167.13
2676.669	-97.7512	-86.2232
3344.638	-23.1146	-15.9504
3492.041	0	0



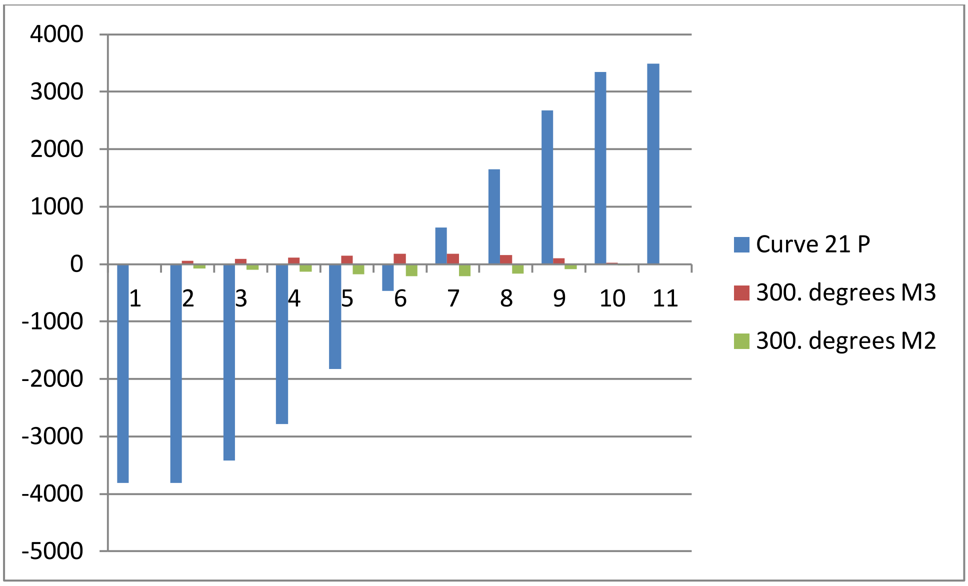




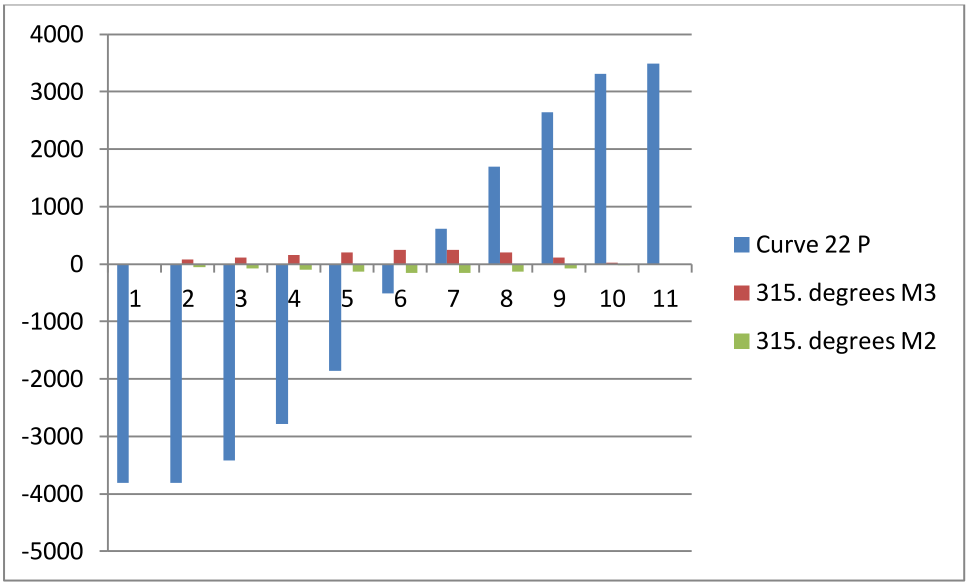
Curve 20	285. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	36.5504	-91.4335
-3320.87	49.1761	-129.102
-2676.62	62.649	-176.336
-1772.67	80.6622	-226.688
-463.69	103.3424	-281.18
455.6915	95.0449	-279.736
1270.447	95.9407	-219.776
2413.218	93.779	-114.665
3375.416	18.0684	-12.9671
3492.041	0	0



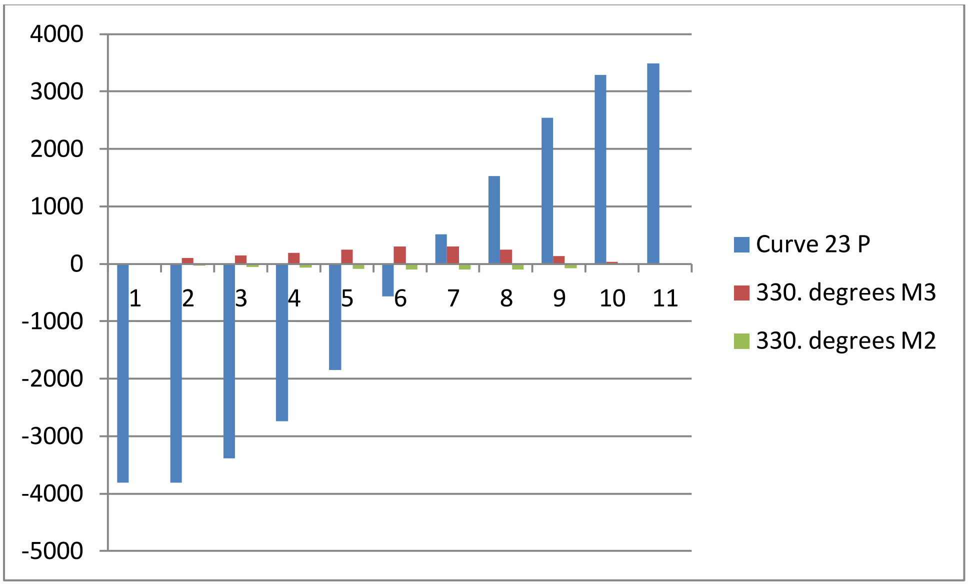
Curve 21	300. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	59.7368	-71.5918
-3424.97	86.1574	-98.111
-2786.26	117.4013	-134.099
-1824.96	149.7527	-174.504
-471.643	184.4768	-212.721
638.9825	182.0104	-214.75
1645.874	157.0087	-167.13
2676.669	97.7512	-86.2232
3344.638	23.1146	-15.9504
3492.041	0	0



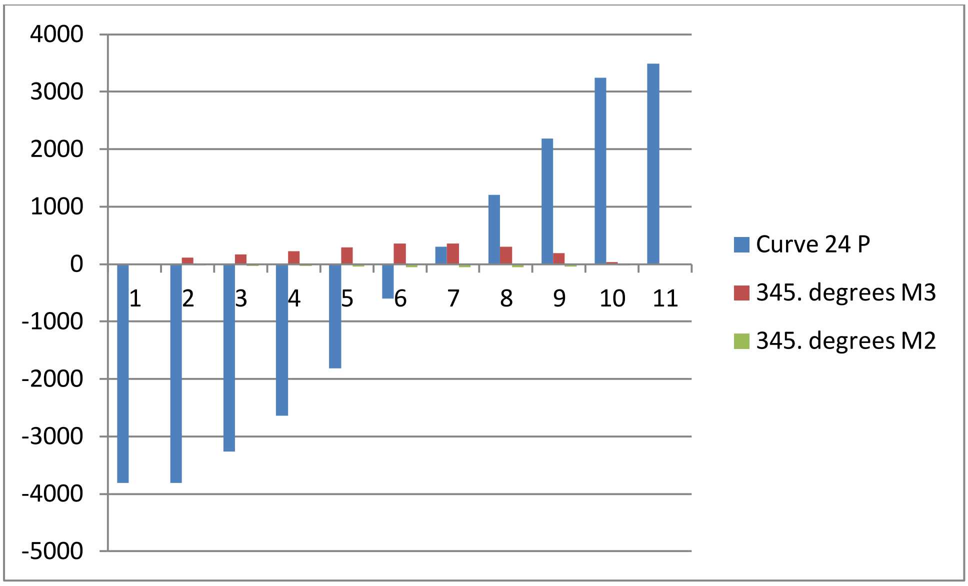
Curve 22	315. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	81.1813	-52.9308
-3425.61	114.1201	-74.7396
-2788.53	158.0658	-99.6959
-1855.68	207.3965	-126.858
-513.94	249.5861	-154.938
615.5763	246.8412	-158.942
1690.337	200.926	-130.413
2647.731	115.0349	-76.639
3316.568	27.5675	-18.7938
3492.041	0	0



Curve 23	330. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	99.3414	-36.8919
-3384.43	141.0471	-51.1633
-2740.04	194.0429	-65.8957
-1846.04	251.3937	-82.8778
-566.681	304.501	-102.069
515.5423	307.8733	-101.008
1531.831	247.0267	-95.5849
2548.06	134.3524	-73.5455
3287.813	32.1687	-21.6891
3492.041	0	0



Curve 24	345. degrees	
P	M3	M2
-3810.3	0	0
-3810.3	117.4401	-21.5068
-3263.16	167.8358	-26.8775
-2645.34	224.1198	-33.7359
-1811.12	286.5337	-40.7831
-604.55	354.7683	-50.3025
298.0932	353.4224	-50.6083
1208.793	301.5445	-52.476
2191.1	194.1542	-45.665
3249.103	38.5784	-25.1397
3492.041	0	0



5.2.1Case 1:model 1

Model 1 is a case in which analysis is done without shear wall.

figure 15

(1)Table 1 beam weight

STORY29	B1	DEAD	2.08	0	-91.78	0	0.089	0	-4.138
STORY29	B1	DEAD	2.54	0	-72.64	0	0.089	0	33.714
STORY29	B1	DEAD	3	0	-52.56	0	0.089	0	62.546
STORY29	B1	DEAD	3.46	0	-32.47	0	0.089	0	82.066
STORY29	B1	DEAD	3.92	0	-13.34	0	0.089	0	92.565
STORY29	B1	DEAD	4.38	0	4.85	0	0.089	0	94.481
STORY29	B1	DEAD	4.84	0	22.07	0	0.089	0	88.253
STORY29	B1	DEAD	5.3	0	38.35	0	0.089	0	74.319
STORY29	B1	LIVE	0.7	0	-24.74	0	0.06	0	-35.066
STORY29	B1	LIVE	1.16	0	-23.46	0	0.06	0	-23.955
STORY29	B1	LIVE	1.62	0	-21.54	0	0.06	0	-13.581
STORY29	B1	LIVE	2.08	0	-18.99	0	0.06	0	-4.235
STORY29	B1	LIVE	2.54	0	-15.8	0	0.06	0	3.791
STORY29	B1	LIVE	3	0	-11.98	0	0.06	0	10.204
STORY29	B1	LIVE	3.46	0	-8.16	0	0.06	0	14.811
STORY29	B1	LIVE	3.92	0	-4.97	0	0.06	0	17.804
STORY29	B1	LIVE	4.38	0	-2.41	0	0.06	0	19.478
STORY29	B1	LIVE	4.84	0	-0.5	0	0.06	0	20.123
STORY29	B1	LIVE	5.3	0	0.79	0	0.06	0	20.032
STORY29	B1	FF	0.7	0	-12.37	0	0.03	0	-17.533
STORY29	B1	FF	1.16	0	-11.73	0	0.03	0	-11.978

STORY29	B1	FF	1.62	0	-10.77	0	0.03	0	-6.79
STORY29	B1	FF	2.08	0	-9.49	0	0.03	0	-2.117
STORY29	B1	FF	2.54	0	-7.9	0	0.03	0	1.896
STORY28	B1	DEAD	0.7	0	-142.8	0	0.1	0	-165.743
STORY28	B1	DEAD	1.16	0	-126.52	0	0.1	0	-103.763
STORY28	B1	DEAD	1.62	0	-109.29	0	0.1	0	-49.489
STORY28	B1	DEAD	2.08	0	-91.11	0	0.1	0	-3.359
STORY28	B1	DEAD	2.54	0	-71.98	0	0.1	0	34.188
STORY28	B1	DEAD	3	0	-51.89	0	0.1	0	62.715
STORY28	B1	DEAD	3.46	0	-31.81	0	0.1	0	81.929
STORY28	B1	DEAD	3.92	0	-12.67	0	0.1	0	92.123
STORY28	B1	DEAD	4.38	0	5.51	0	0.1	0	93.734
STORY28	B1	DEAD	4.84	0	22.74	0	0.1	0	87.2
STORY28	B1	DEAD	5.3	0	39.02	0	0.1	0	72.96
STORY28	B1	LIVE	0.7	0	-24.6	0	0.067	0	-34.716
STORY28	B1	LIVE	1.16	0	-23.32	0	0.067	0	-23.67
STORY28	B1	LIVE	1.62	0	-21.4	0	0.067	0	-13.361
STORY28	B1	LIVE	2.08	0	-18.85	0	0.067	0	-4.08
STORY28	B1	LIVE	2.54	0	-15.66	0	0.067	0	3.881
STORY28	B1	LIVE	3	0	-11.84	0	0.067	0	10.23
STORY28	B1	LIVE	3.46	0	-8.01	0	0.067	0	14.771
STORY28	B1	LIVE	3.92	0	-4.83	0	0.067	0	17.7
STORY28	B1	LIVE	4.38	0	-2.27	0	0.067	0	19.308
STORY28	B1	LIVE	4.84	0	-0.35	0	0.067	0	19.888
STORY28	B1	LIVE	5.3	0	0.93	0	0.067	0	19.732
STORY28	B1	FF	0.7	0	-12.3	0	0.033	0	-17.358
STORY28	B1	FF	1.16	0	-11.66	0	0.033	0	-11.835
STORY28	B1	FF	1.62	0	-10.7	0	0.033	0	-6.68
STORY28	B1	FF	2.08	0	-9.42	0	0.033	0	-2.04
STORY28	B1	FF	2.54	0	-7.83	0	0.033	0	1.941
STORY28	B1	FF	3	0	-5.92	0	0.033	0	5.115
STORY28	B1	FF	3.46	0	-4.01	0	0.033	0	7.385
STORY28	B1	FF	3.92	0	-2.41	0	0.033	0	8.85
STORY28	B1	FF	4.38	0	-1.14	0	0.033	0	9.654
STORY28	B1	FF	4.84	0	-0.18	0	0.033	0	9.944
STORY28	B1	FF	5.3	0	0.46	0	0.033	0	9.866
STORY28	B1	WALL	0.7	0	0	0	0	0	0
STORY28	B1	WALL	1.16	0	0	0	0	0	0
STORY28	B1	WALL	1.62	0	0	0	0	0	0

STORY28	B1	WALL	2.08	0	0	0	0	0	0
STORY28	B1	WALL	2.54	0	0	0	0	0	0
STORY28	B1	WALL	3	0	0	0	0	0	0
STORY28	B1	WALL	3.46	0	0	0	0	0	0
STORY28	B1	WALL	3.92	0	0	0	0	0	0
STORY28	B1	WALL	4.38	0	0	0	0	0	0
STORY28	B1	WALL	4.84	0	0	0	0	0	0
STORY28	B1	WALL	5.3	0	0	0	0	0	0
STORY28	B1	EQXPY	0.7	0	7.44	0	1.406	0	17.312
STORY28	B1	EQXPY	1.16	0	7.44	0	1.406	0	13.892
STORY28	B1	EQXPY	1.62	0	7.44	0	1.406	0	10.471
STORY28	B1	EQXPY	2.08	0	7.44	0	1.406	0	7.051
STORY28	B1	EQXPY	2.54	0	7.44	0	1.406	0	3.63
STORY28	B1	EQXPY	3	0	7.44	0	1.406	0	0.21
STORY28	B1	EQXPY	3.46	0	7.44	0	1.406	0	-3.21
STORY27	B1	DEAD	0.7	0	-142.61	0	0.099	0	-165.328
STORY27	B1	DEAD	1.16	0	-126.33	0	0.099	0	-103.436
STORY27	B1	DEAD	1.62	0	-109.1	0	0.099	0	-49.25
STORY27	B1	DEAD	2.08	0	-90.92	0	0.099	0	-3.208
STORY27	B1	DEAD	2.54	0	-71.79	0	0.099	0	34.251
STORY27	B1	DEAD	3	0	-51.7	0	0.099	0	62.689
STORY27	B1	DEAD	3.46	0	-31.61	0	0.099	0	81.815
STORY27	B1	DEAD	3.92	0	-12.48	0	0.099	0	91.921
STORY27	B1	DEAD	4.38	0	5.7	0	0.099	0	93.444
STORY27	B1	DEAD	4.84	0	22.93	0	0.099	0	86.822
STORY27	B1	DEAD	5.3	0	39.21	0	0.099	0	72.494
STORY27	B1	LIVE	0.7	0	-24.55	0	0.066	0	-34.612
STORY27	B1	LIVE	1.16	0	-23.27	0	0.066	0	-23.587
STORY27	B1	LIVE	1.62	0	-21.35	0	0.066	0	-13.3
STORY27	B1	LIVE	2.08	0	-18.8	0	0.066	0	-4.04
STORY27	B1	LIVE	2.54	0	-15.61	0	0.066	0	3.899
STORY27	B1	LIVE	3	0	-11.79	0	0.066	0	10.226
STORY27	B1	LIVE	3.46	0	-7.97	0	0.066	0	14.745
STORY27	B1	LIVE	3.92	0	-4.78	0	0.066	0	17.653
STORY27	B1	LIVE	4.38	0	-2.23	0	0.066	0	19.239
STORY27	B1	LIVE	4.84	0	-0.31	0	0.066	0	19.798
STORY27	B1	LIVE	5.3	0	0.98	0	0.066	0	19.62
STORY27	B1	FF	0.7	0	-12.28	0	0.033	0	-17.306
STORY27	B1	FF	1.16	0	-11.64	0	0.033	0	-11.794

STORY27	B1	FF	1.62	0	-10.68	0	0.033	0	-6.65
STORY27	B1	FF	2.08	0	-9.4	0	0.033	0	-2.02
STORY27	B1	FF	2.54	0	-7.81	0	0.033	0	1.949
STORY27	B1	FF	3	0	-5.89	0	0.033	0	5.113
STORY27	B1	FF	3.46	0	-3.98	0	0.033	0	7.373
STORY27	B1	FF	3.92	0	-2.39	0	0.033	0	8.826
STORY27	B1	FF	4.38	0	-1.11	0	0.033	0	9.62
STORY27	B1	FF	4.84	0	-0.15	0	0.033	0	9.899
STORY27	B1	FF	5.3	0	0.49	0	0.033	0	9.81
STORY27	B1	WALL	0.7	0	0	0	0	0	0
STORY27	B1	WALL	1.16	0	0	0	0	0	0
STORY27	B1	WALL	1.62	0	0	0	0	0	0
STORY26	B1	DEAD	0.7	0	-142.25	0	0.099	0	-164.502
STORY26	B1	DEAD	1.16	0	-125.97	0	0.099	0	-102.774
STORY26	B1	DEAD	1.62	0	-108.74	0	0.099	0	-48.753
STORY26	B1	DEAD	2.08	0	-90.56	0	0.099	0	-2.876
STORY26	B1	DEAD	2.54	0	-71.43	0	0.099	0	34.419
STORY26	B1	DEAD	3	0	-51.34	0	0.099	0	62.693
STORY26	B1	DEAD	3.46	0	-31.26	0	0.099	0	81.655
STORY26	B1	DEAD	3.92	0	-12.12	0	0.099	0	91.596
STORY26	B1	DEAD	4.38	0	6.06	0	0.099	0	92.954
STORY26	B1	DEAD	4.84	0	23.29	0	0.099	0	86.168
STORY26	B1	DEAD	5.3	0	39.56	0	0.099	0	71.676
STORY26	B1	LIVE	0.7	0	-24.47	0	0.066	0	-34.418
STORY26	B1	LIVE	1.16	0	-23.19	0	0.066	0	-23.433
STORY26	B1	LIVE	1.62	0	-21.27	0	0.066	0	-13.183
STORY26	B1	LIVE	2.08	0	-18.72	0	0.066	0	-3.962
STORY26	B1	LIVE	2.54	0	-15.53	0	0.066	0	3.938
STORY26	B1	LIVE	3	0	-11.71	0	0.066	0	10.226
STORY26	B1	LIVE	3.46	0	-7.88	0	0.066	0	14.707
STORY26	B1	LIVE	3.92	0	-4.7	0	0.066	0	17.576
STORY26	B1	LIVE	4.38	0	-2.14	0	0.066	0	19.124
STORY26	B1	LIVE	4.84	0	-0.22	0	0.066	0	19.644
STORY26	B1	LIVE	5.3	0	1.06	0	0.066	0	19.428
STORY26	B1	FF	0.7	0	-12.24	0	0.033	0	-17.209
STORY26	B1	FF	1.16	0	-11.59	0	0.033	0	-11.716
STORY26	B1	FF	1.62	0	-10.63	0	0.033	0	-6.592
STORY26	B1	FF	2.08	0	-9.36	0	0.033	0	-1.981
STORY26	B1	FF	2.54	0	-7.76	0	0.033	0	1.969

STORY26	B1	FF	3	0	-5.85	0	0.033	0	5.113
STORY26	B1	FF	3.46	0	-3.94	0	0.033	0	7.354
STORY26	B1	FF	3.92	0	-2.35	0	0.033	0	8.788
STORY26	B1	FF	4.38	0	-1.07	0	0.033	0	9.562
STORY26	B1	FF	4.84	0	-0.11	0	0.033	0	9.822
STORY26	B1	FF	5.3	0	0.53	0	0.033	0	9.714
STORY26	B1	WALL	0.7	0	0	0	0	0	0
STORY26	B1	WALL	1.16	0	0	0	0	0	0
STORY26	B1	WALL	1.62	0	0	0	0	0	0
STORY26	B1	WALL	2.08	0	0	0	0	0	0
STORY26	B1	WALL	2.54	0	0	0	0	0	0
STORY26	B1	WALL	3	0	0	0	0	0	0
STORY26	B1	WALL	3.46	0	0	0	0	0	0
STORY26	B1	WALL	3.92	0	0	0	0	0	0
STORY26	B1	WALL	4.38	0	0	0	0	0	0
STORY26	B1	WALL	4.84	0	0	0	0	0	0
STORY26	B1	WALL	5.3	0	0	0	0	0	0
STORY26	B1	EQXPY	0.7	0	12.14	0	2.154	0	28.206
STORY26	B1	EQXPY	1.16	0	12.14	0	2.154	0	22.623
STORY26	B1	EQXPY	1.62	0	12.14	0	2.154	0	17.04
STORY26	B1	EQXPY	2.08	0	12.14	0	2.154	0	11.457
STORY26	B1	EQXPY	2.54	0	12.14	0	2.154	0	5.874
STORY26	B1	EQXPY	3	0	12.14	0	2.154	0	0.29
STORY26	B1	EQXPY	3.46	0	12.14	0	2.154	0	-5.293
STORY26	B1	EQXPY	3.92	0	12.14	0	2.154	0	-10.876
STORY26	B1	EQXPY	4.38	0	12.14	0	2.154	0	-16.459
STORY26	B1	EQXPY	4.84	0	12.14	0	2.154	0	-22.043
STORY26	B1	EQXPY	5.3	0	12.14	0	2.154	0	-27.626
STORY26	B1	EQXNY	0.7	0	-12.14	0	-2.154	0	-28.206
STORY26	B1	EQXNY	1.16	0	-12.14	0	-2.154	0	-22.623
STORY26	B1	EQXNY	1.62	0	-12.14	0	-2.154	0	-17.04
STORY26	B1	EQXNY	2.08	0	-12.14	0	-2.154	0	-11.457
STORY26	B1	EQXNY	2.54	0	-12.14	0	-2.154	0	-5.874
STORY26	B1	EQXNY	3	0	-12.14	0	-2.154	0	-0.29
STORY26	B1	EQXNY	3.46	0	-12.14	0	-2.154	0	5.293
STORY26	B1	EQXNY	3.92	0	-12.14	0	-2.154	0	10.876
STORY26	B1	EQXNY	4.38	0	-12.14	0	-2.154	0	16.459
STORY26	B1	EQXNY	4.84	0	-12.14	0	-2.154	0	22.043
STORY26	B1	EQXNY	5.3	0	-12.14	0	-2.154	0	27.626
STORY26	B1	EQYPX	0.7	0	154.53	0	-2.154	0	359.364
STORY26	B1	EQYPX	1.16	0	154.53	0	-2.154	0	288.279

STORY26	B1	EQYPX	1.62	0	154.53	0	-2.154	0	217.194
STORY26	B1	EQYPX	2.08	0	154.53	0	-2.154	0	146.109
STORY26	B1	EQYPX	2.54	0	154.53	0	-2.154	0	75.023
STORY26	B1	EQYPX	3	0	154.53	0	-2.154	0	3.938
STORY26	B1	EQYPX	3.46	0	154.53	0	-2.154	0	-67.147
STORY26	B1	EQYPX	3.92	0	154.53	0	-2.154	0	-138.232
STORY26	B1	EQYPX	4.38	0	154.53	0	-2.154	0	-209.318
STORY26	B1	EQYPX	4.84	0	154.53	0	-2.154	0	-280.403
STORY26	B1	EQYPX	5.3	0	154.53	0	-2.154	0	-351.488
STORY26	B1	EQYNX	0.7	0	178.81	0	2.154	0	415.777
STORY26	B1	EQYNX	1.16	0	178.81	0	2.154	0	333.526
STORY26	B1	EQYNX	1.62	0	178.81	0	2.154	0	251.274
STORY26	B1	EQYNX	2.08	0	178.81	0	2.154	0	169.022
STORY26	B1	EQYNX	2.54	0	178.81	0	2.154	0	86.77
STORY26	B1	EQYNX	3	0	178.81	0	2.154	0	4.519
STORY26	B1	EQYNX	3.46	0	178.81	0	2.154	0	-77.733
STORY26	B1	EQYNX	3.92	0	178.81	0	2.154	0	-159.985
STORY26	B1	EQYNX	4.38	0	178.81	0	2.154	0	-242.236
STORY26	B1	EQYNX	4.84	0	178.81	0	2.154	0	-324.488
STORY26	B1	EQYNX	5.3	0	178.81	0	2.154	0	-406.74
STORY25	B1	DEAD	0.7	0	-141.82	0	0.099	0	-163.507
STORY25	B1	DEAD	1.16	0	-125.54	0	0.099	0	-101.979
STORY25	B1	DEAD	1.62	0	-108.31	0	0.099	0	-48.156
STORY25	B1	DEAD	2.08	0	-90.13	0	0.099	0	-2.478
STORY25	B1	DEAD	2.54	0	-71	0	0.099	0	34.617
STORY25	B1	DEAD	3	0	-50.91	0	0.099	0	62.692
STORY25	B1	DEAD	3.46	0	-30.82	0	0.099	0	81.455
STORY25	B1	DEAD	3.92	0	-11.69	0	0.099	0	91.197
STORY25	B1	DEAD	4.38	0	6.49	0	0.099	0	92.356
STORY25	B1	DEAD	4.84	0	23.72	0	0.099	0	85.371
STORY25	B1	DEAD	5.3	0	40	0	0.099	0	70.68
STORY25	B1	LIVE	0.7	0	-24.37	0	0.066	0	-34.184

STORY25	B1	LIVE	1.16	0	-23.09	0	0.066	0	-23.245
STORY25	B1	LIVE	1.62	0	-21.17	0	0.066	0	-13.043
STORY25	B1	LIVE	2.08	0	-18.61	0	0.066	0	-3.869
STORY25	B1	LIVE	2.54	0	-15.43	0	0.066	0	3.985
STORY25	B1	LIVE	3	0	-11.6	0	0.066	0	10.226
STORY25	B1	LIVE	3.46	0	-7.78	0	0.066	0	14.66
STORY25	B1	LIVE	3.92	0	-4.59	0	0.066	0	17.482

story	max displacement	max story shear	drift x	drift y
30	0.1628	-958.89	0.000986	0.000021
29	0.1597	-2094.18	0.001062	0.000026
28	0.1563	-3152.52	0.001162	0.000034
27	0.1527	-4136.62	0.001272	0.000042
26	0.1487	-5049.17	0.001386	0.00005
25	0.1444	-5892.88	0.001497	0.000058
24	0.1398	-6670.44	0.001603	0.000065
23	0.1348	-7384.55	0.001703	0.000072
22	0.1295	-8037.91	0.001794	0.000079
21	0.1239	-8633.23	0.001877	0.000085
20	0.1181	-9173.2	0.001951	0.000091
19	0.112	-9660.52	0.002016	0.000096
18	0.1058	-10097.9	0.002072	0.0001
17	0.0994	-10488.03	0.002119	0.000104
16	0.0929	-10833.61	0.002158	0.000108
15	0.0862	-11137.34	0.002188	0.000111
14	0.0795	-11401.93	0.00221	0.000114
13	0.0727	-11630.07	0.002224	0.000116
12	0.0659	-11824.46	0.002228	0.000118
11	0.059	-11987.8	0.002224	0.00012
10	0.0522	-12122.79	0.002209	0.000121
9	0.0454	-12232.14	0.002183	0.000122
8	0.0388	-12318.53	0.002143	0.000126
7	0.0322	-12384.68	0.002084	0.000128
6	0.0259	-12433.27	0.001999	0.00012
5	0.0198	-12467.02	0.001877	0.000116
4	0.0141	-12488.62	0.001699	0.000109
3	0.0089	-12500.77	0.001435	0.000097
2	0.0045	-12506.17	0.001038	0.000074
1	0.0013	-12507.52	0.000434	0.000033

Summation	0, 0, Base	DEAD	0	0	246175.2	2215577	-2215577	0
Summation	0, 0, Base	LIVE	0	0	38880	349920	-349920	0
Summation	0, 0, Base	FF	0	0	19440	174960	-174960	0
Summation	0, 0, Base	WALL	0	0	62100	558900	-583200	0
Summation	0, 0, Base	EQXPY	-12601.6	0	0	0	-858861	124756
Summation	0, 0, Base	EQXNY	-12601.6	0	0	0	-858861	102073.1
Summation	0, 0, Base	EQYPX	0	-12601.6	0	858861.3	0	-126239
Summation	0, 0, Base	EQYNX	0	-12601.6	0	858861.3	0	-102567

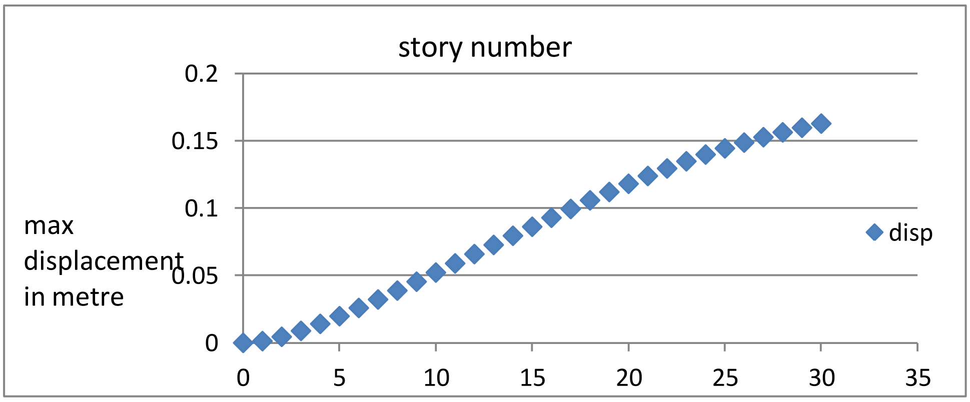


Figure 16

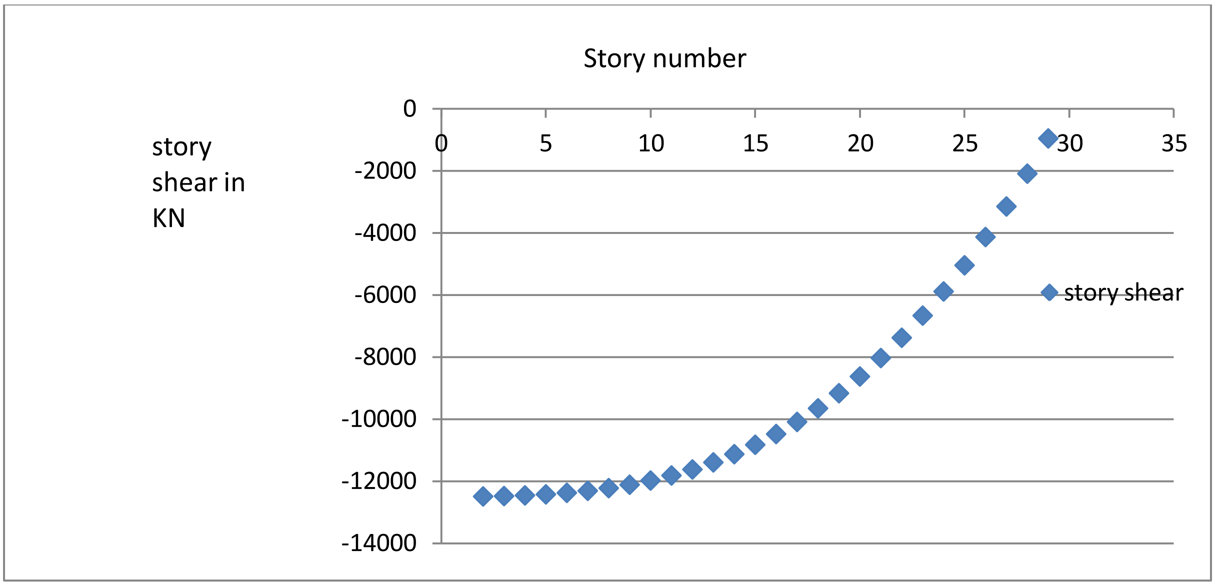


Figure 17

(4)Graphical representation of story drift in x and y direction for model 1

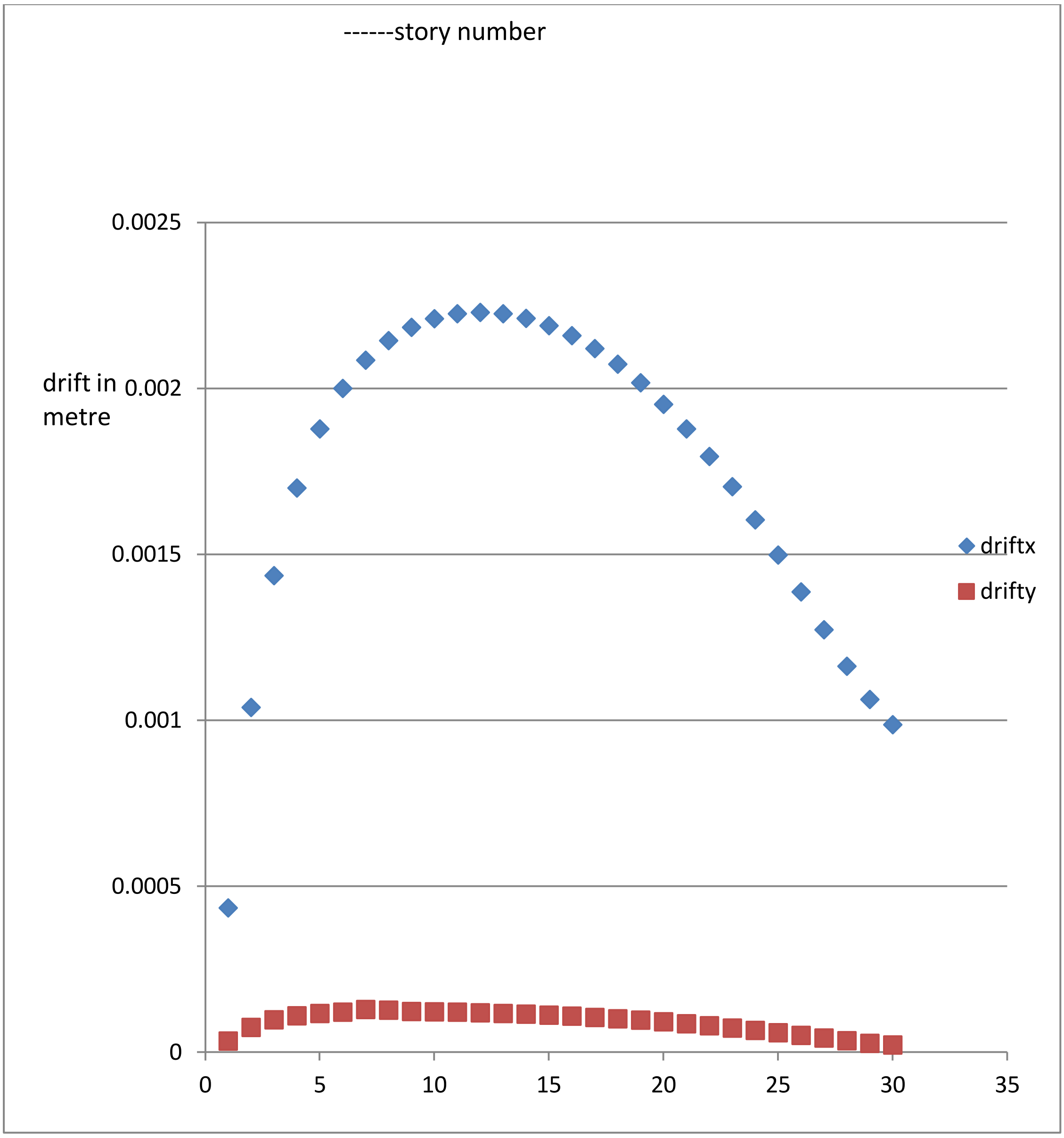


Figure 17

5.2.2Case 2 :

(1)Table 2

story	max displacement	max story shear	drift x	drift y
30	0.1529	-958.77	0.000971	0.000029
29	0.15	-2103.32	0.001044	0.000034
28	0.1469	-3170.3	0.001141	0.000039
27	0.1435	-4162.42	0.001247	0.000044
26	0.1359	-5082.42	0.001356	0.000049
25	0.1357	-5933.01	0.001463	0.000054
24	0.1313	-6716.91	0.001565	0.000059
23	0.1266	-7436.85	0.001659	0.000063
22	0.1216	-8095.54	0.001746	0.000067
21	0.1164	-8695.72	0.001824	0.000071
20	0.1109	-9240.09	0.001894	0.000075
19	0.1052	-9731.39	0.001955	0.000078
18	0.0993	-10172.34	0.002006	0.000081
17	0.0933	-10565.65	0.00205	0.000083
16	0.0872	-10914.05	0.002084	0.000085
15	0.0809	-11220.26	0.002111	0.000087
14	0.0746	-11487.01	0.002129	0.000088
13	0.0682	-11717.01	0.002139	0.000089
12	0.0618	-11912.98	0.00214	0.000089
11	0.0554	-12077.66	0.002133	0.000089
10	0.0475	-12213.75	0.002116	0.000089
9	0.0426	-12323.99	0.002088	0.000088
8	0.0364	-12411.09	0.002046	0.000086
7	0.0302	-12477.77	0.001988	0.000084
6	0.0243	-12526.77	0.001905	0.000081
5	0.0185	-12560.79	0.001787	0.000077
4	0.0132	-12582.57	0.001617	0.000072
3	0.0083	-12594.81	0.001368	0.000063
2	0.0042	-12600.26	0.000993	0.00005
1	0.0013	-12601.62	0.000417	0.000023

Summation 0, 0, Base DEAD	0	0	310802.4	2797222	-2797222	0
Summation 0, 0, Base LIVE	0	0	29160	262440	-262440	0

Summation 0, 0, Base FF	0	0	14580	131220	-131220	0
Summation 0, 0, Base WALL	0	0	0	0	0	0
Summation 0, 0, Base EQXPY	-12507.5	0	0	0	-877054	123824.5
Summation 0, 0, Base EQXNY	-12507.5	0	0	0	-877054	101310.9
Summation 0, 0, Base EQYPX	0	-12507.5	0	878273.7	0	-123824
Summation 0, 0, Base EQYNX	0	-12507.5	0	878273.7	0	-101311

(2)Graphical representation of displacement for model 2:

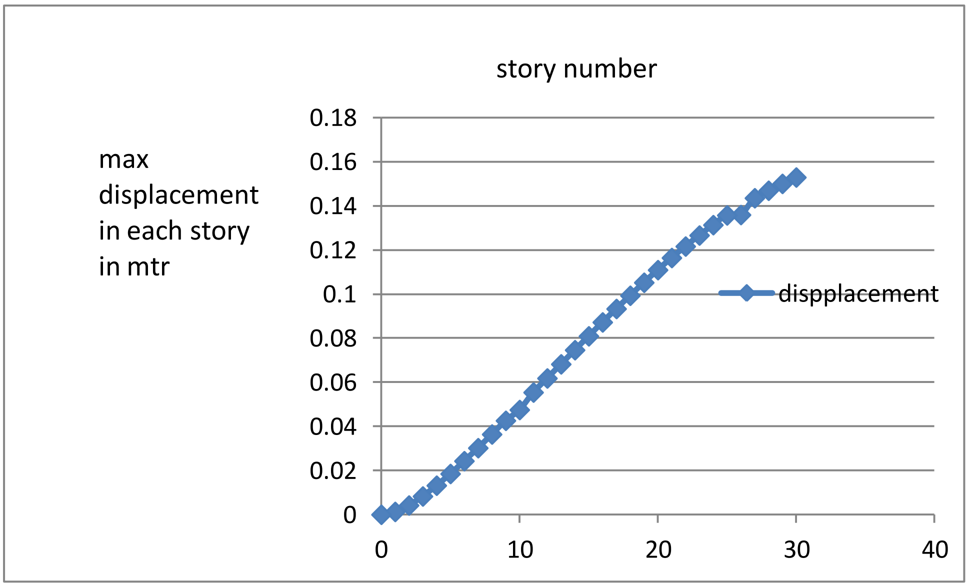


Figure 20

(2)Graphical representation of story shear for model 2:

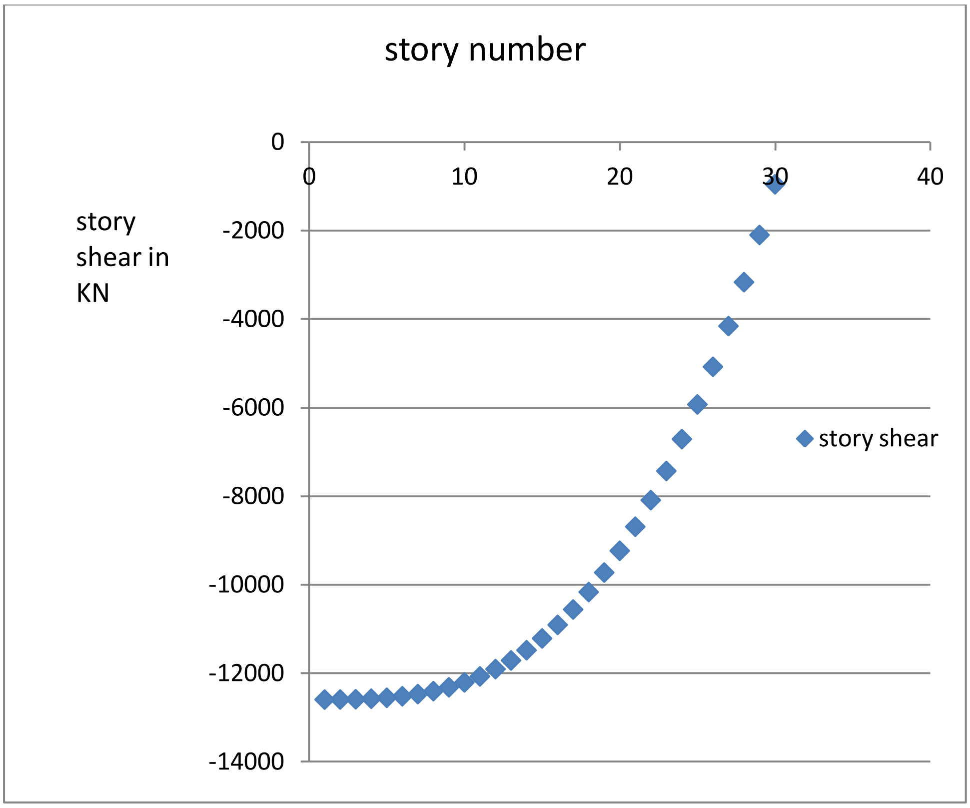


figure 21

(4)Graphical representation of story drift in X and Y direction for model 2:

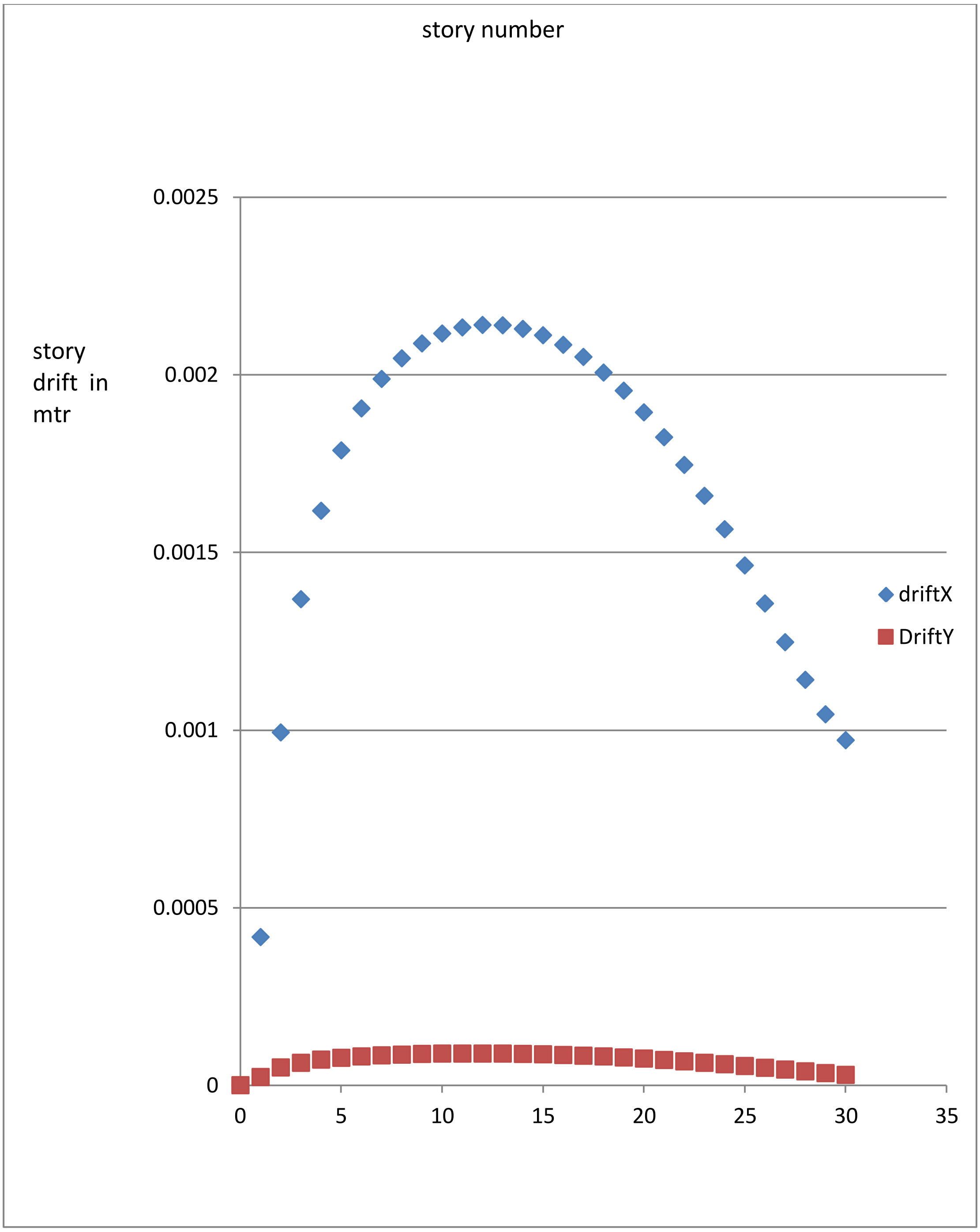


Figure 22

5.2.3Case 3:

(1)Table 3

story	max displacement	max story shear	drift x	drift y
30	0.1585	-1007.34	0.001044	0.000028
29	0.1555	-2224.43	0.001132	0.000033
28	0.1524	-3359.04	0.001238	0.000039
27	0.1487	-4414.05	0.00135	0.000045
26	0.1451	-5392.35	0.001462	0.000051
25	0.1409	-6296.85	0.001569	0.000057
24	0.1364	-7130.44	0.001671	0.000063
23	0.136	-7896.01	0.001765	0.000068
22	0.1265	-8596.45	0.001857	0.000072
21	0.1211	-9234.67	0.00194	0.000077
20	0.1112	-9813.55	0.002014	0.000081
19	0.1096	-10335.99	0.002079	0.000085
18	0.1036	-10804.88	0.002134	0.000088
17	0.0974	-11223.12	0.002181	0.000091
16	0.091	-11593.61	0.002218	0.000093
15	0.0845	-11919.23	0.002246	0.000095
14	0.075	-12202.88	0.002266	0.000097
13	0.0713	-12447.45	0.002276	0.000098
12	0.0647	-12655.85	0.002278	0.000099
11	0.058	-12830.96	0.00227	0.000099
10	0.051	-12975.68	0.002253	0.000099
9	0.0447	-13092.91	0.002223	0.000098
8	0.0381	-13185.53	0.00218	0.000097
7	0.0317	-13256.44	0.002118	0.000095
6	0.0254	-13308.54	0.002031	0.000093
5	0.0194	-13344.72	0.001906	0.000089
4	0.0138	-13367.87	0.001726	0.000083
3	0.0087	-13380.9	0.00146	0.000074
2	0.0044	-13386.69	0.00106	0.000058
1	0.0013	-13388.13	0.000445	0.000027

Summatic	0, 0, Base	DEAD	0	0	310802.4	2797222	-2797222	0
Summatic	0, 0, Base	LIVE	0	0	29160	262440	-262440	0
Summatic	0, 0, Base	FF	0	0	14580	131220	-131220	0
Summatic	0, 0, Base	WALL	0	0	0	0	0	0
Summatic	0, 0, Base	EQXPY	-12507.5	0	0	0	-877054	123824.5
Summatic	0, 0, Base	EQXNY	-12507.5	0	0	0	-877054	101310.9
Summatic	0, 0, Base	EQYPX	0	-12507.5	0	878273.7	0	-123824
Summatic	0, 0, Base	EQYNX	0	-12507.5	0	878273.7	0	-101311

(2)Graphical representation of story displacement for model 3

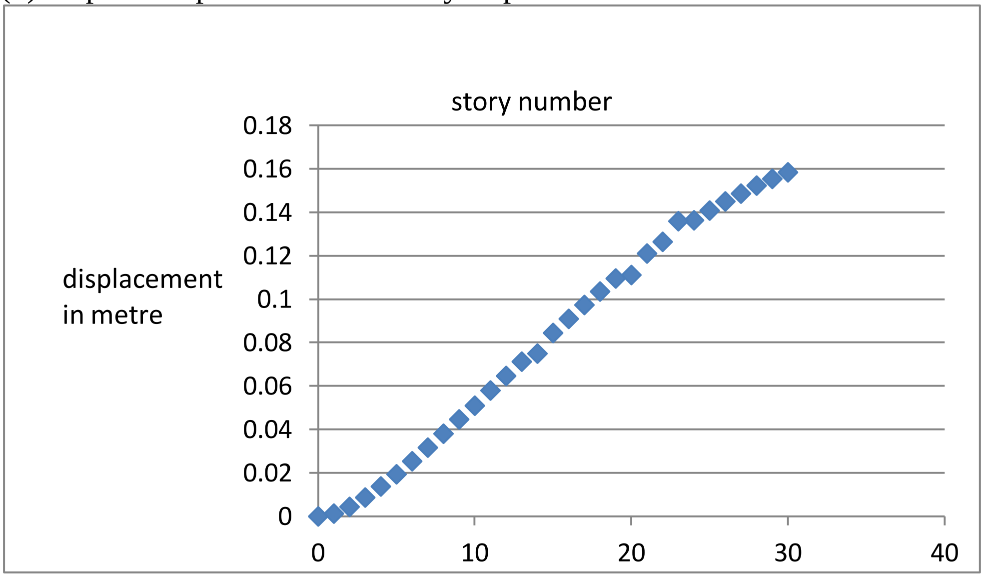


Figure 25

(3)Graphical representation of story shear for model 3:

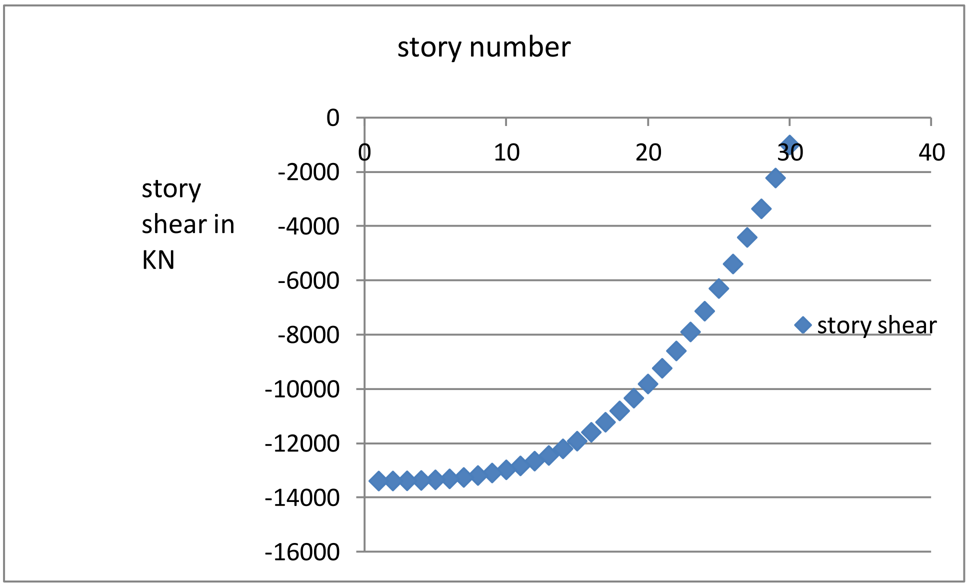


Figure 26

(4)Graphical representation of story drift in X and Y direction for model 3:

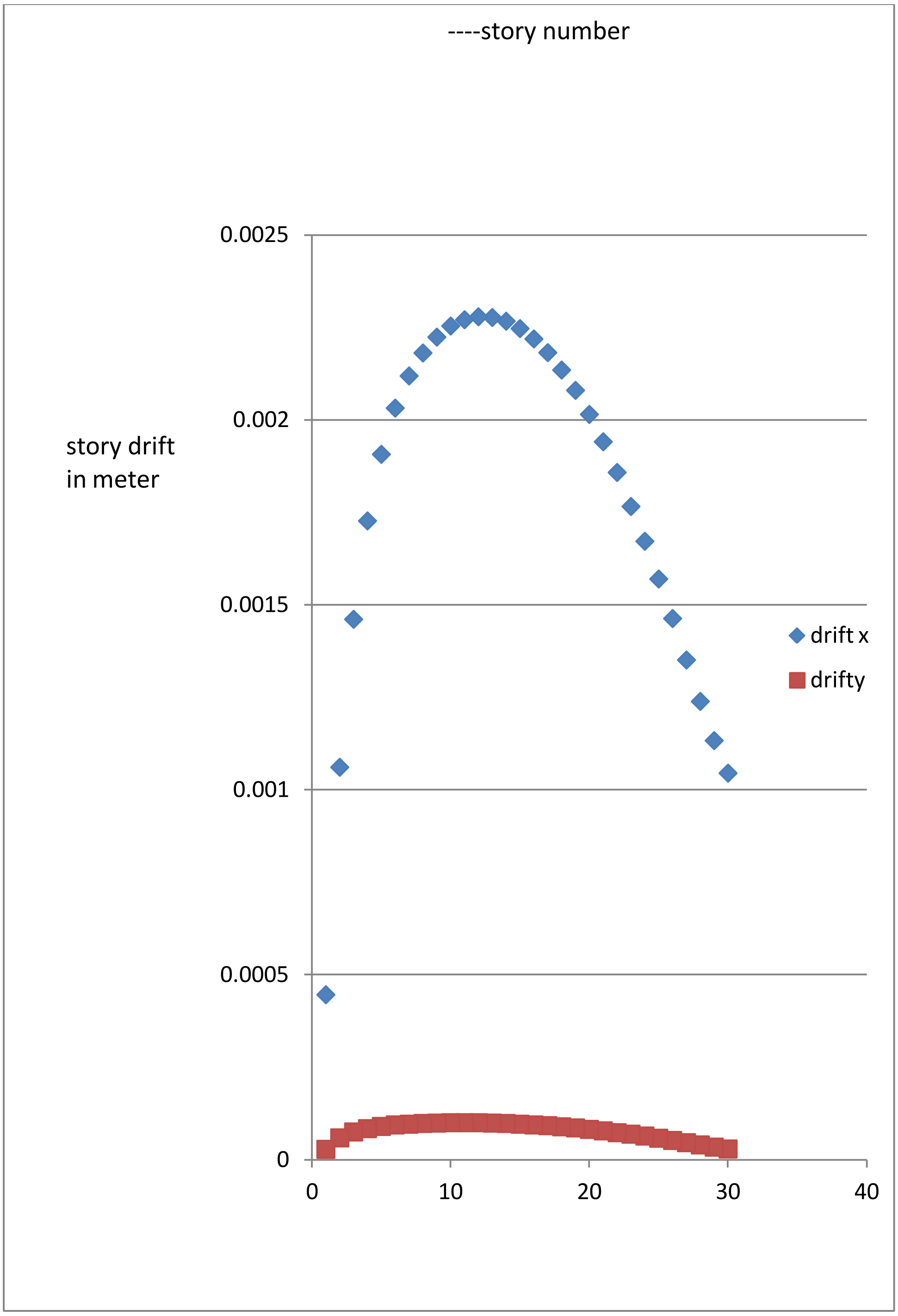


Figure 27

(1)Table 4

story	max displacement	max story shear	drift x	drift y

30	0.1107	-994.37	0.001035	0.000011
29	0.1076	-2195.31	0.00108	0.000015
28	0.1044	-3314.85	0.001127	0.00002
27	0.101	-4355.86	0.001175	0.000026
26	0.0975	-5321.18	0.001223	0.000031
25	0.0938	-6213.67	0.00127	0.000036
24	0.09	-7036.19	0.001314	0.000041
23	0.0861	-7791.6	0.001356	0.000045
22	0.082	-8482.75	0.001393	0.00005
21	0.0778	-9112.49	0.001426	0.000053
20	0.0735	-9683.69	0.001454	0.000057
19	0.0692	-10199.19	0.001477	0.00006
18	0.0647	-10661.86	0.001493	0.000063
17	0.0603	-11074.55	0.001504	0.000065
16	0.0558	-11440.11	0.001508	0.000067
15	0.0512	-11761.41	0.001505	0.000069
14	0.0467	-12041.3	0.001496	0.000071
13	0.0422	-12282.63	0.001478	0.000072
12	0.0378	-12488.26	0.001453	0.000073
11	0.0334	-12661.04	0.00142	0.000074
10	0.0292	-12803.84	0.001378	0.000075
9	0.025	-12919.51	0.001326	0.000076
8	0.0211	-13010.9	0.001265	0.000076
7	0.0173	-13080.87	0.001192	0.000076
6	0.0137	-13132.28	0.001108	0.000076
5	0.0104	-13167.98	0.001009	0.000075
4	0.0073	-13190.83	0.000892	0.000072
3	0.0047	-13203.68	0.000748	0.000066
2	0.0024	-13209.39	0.000555	0.000053
1	0.0008	-13210.82	0.000253	0.000025

BASE	16	SPEC2	0.44	263.32	3281.44	1136.802	0.206	0
Summatic	0, 0, Base	DEAD	0	0	323762.4	2913862	-2913862	0
Summatic	0, 0, Base	LIVE	0	0	35640	320760	-320760	0
Summatic	0, 0, Base	FF	0	0	17820	160380	-160380	0
Summatic	0, 0, Base	WALL	0	0	0	0	0	0
Summatic	0, 0, Base	EQXPY	-13210.8	0	0	0	-900127	130787.1
Summatic	0, 0, Base	EQXNY	-13210.8	0	0	0	-900127	107007.6
Summatic	0, 0, Base	EQYPX	0	-13210.8	0	900127.2	0	-130787
Summatic	0, 0, Base	EQYNX	0	-13210.8	0	900127.2	0	-107008

(2)Graphical representation of story displacement for model 4:

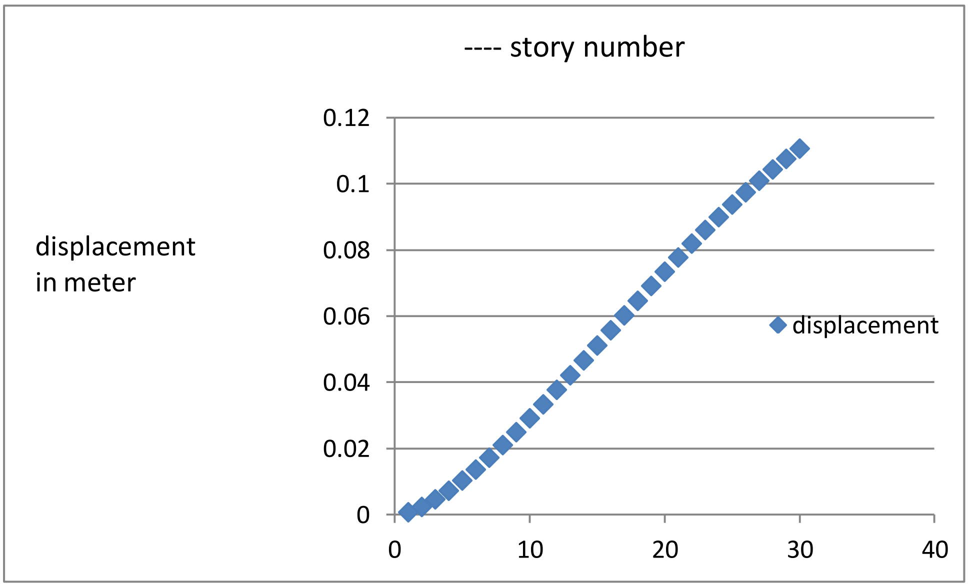


Figure 30

(3)Graphical representation of story shear for model 4:

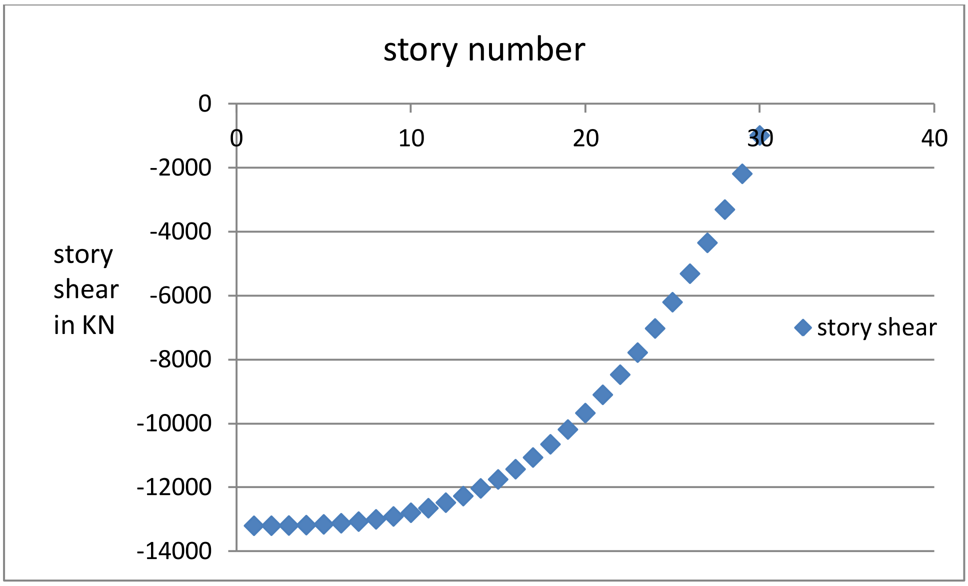


Figure 31

(4)Graphical representation of story drift in X and Y direction for model 4:

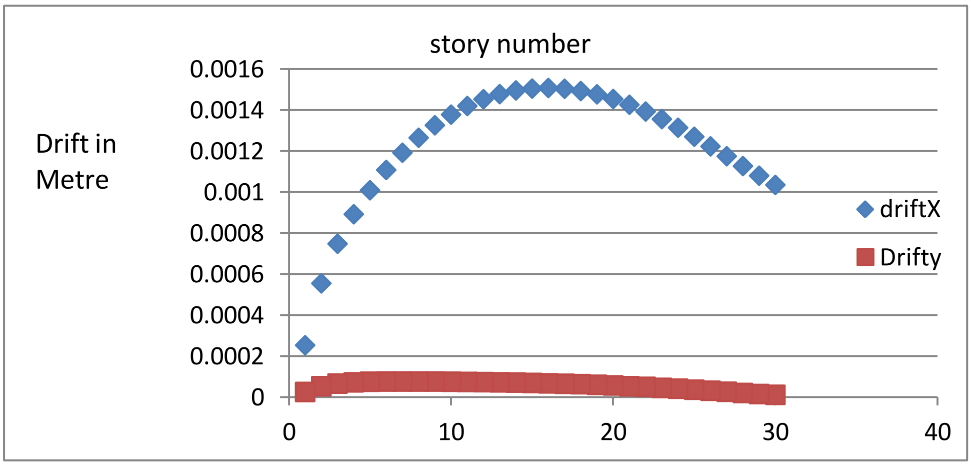


Figure 32

5.3.1 comparison of all four cases:

(1) max displacement :Table 5

	max disp of	max disp of	max disp of	max disp of

	model 1	model 2	model 3	model 4
max disp	0.1628	0.1529	0.1585	0.1107

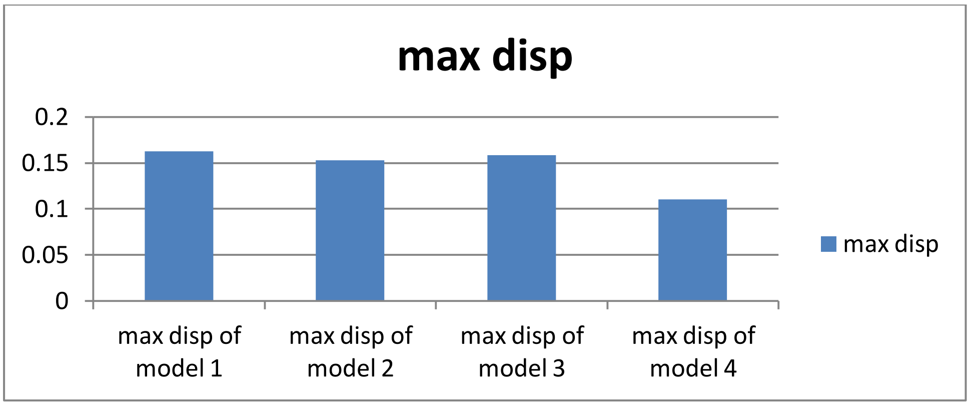


Figure 32

(2) max story shear:Table 5

story	story shear in model 1	story shear model2	story shear in model 3	st.shr m4
30	-958.89	-958.77	-1007.34	-994.37
29	-2094.18	-2103.32	-2224.43	-2195.31
28	-3152.52	-3170.3	-3359.04	-3314.85
27	-4136.62	-4162.42	-4414.05	-4355.86
26	-5049.17	-5082.42	-5392.35	-5321.18
25	-5892.88	-5933.01	-6296.85	-6213.67
24	-6670.44	-6716.91	-7130.44	-7036.19
23	-7384.55	-7436.85	-7896.01	-7791.6
22	-8037.91	-8095.54	-8596.45	-8482.75
21	-8633.23	-8695.72	-9234.67	-9112.49
20	-9173.2	-9240.09	-9813.55	-9683.69
19	-9660.52	-9731.39	-10335.99	-10199.2
18	-10097.9	-10172.34	-10804.88	-10661.9
17	-10488.03	-10565.65	-11223.12	-11074.6
16	-10833.61	-10914.05	-11593.61	-11440.1
15	-11137.34	-11220.26	-11919.23	-11761.4
14	-11401.93	-11487.01	-12202.88	-12041.3
13	-11630.07	-11717.01	-12447.45	-12282.6
12	-11824.46	-11912.98	-12655.85	-12488.3
11	-11987.8	-12077.66	-12830.96	-12661
10	-12122.79	-12213.75	-12975.68	-12803.8
9	-12232.14	-12323.99	-13092.91	-12919.5
8	-12318.53	-12411.09	-13185.53	-13010.9
7	-12384.68	-12477.77	-13256.44	-13080.9
6	-12433.27	-12526.77	-13308.54	-13132.3
5	-12467.02	-12560.79	-13344.72	-13168
4	-12488.62	-12582.57	-13367.87	-13190.8
3	-12500.77	-12594.81	-13380.9	-13203.7
2	-12506.17	-12600.26	-13386.69	-13209.4
1	-12507.52	-12601.62	-13388.13	-13210.8

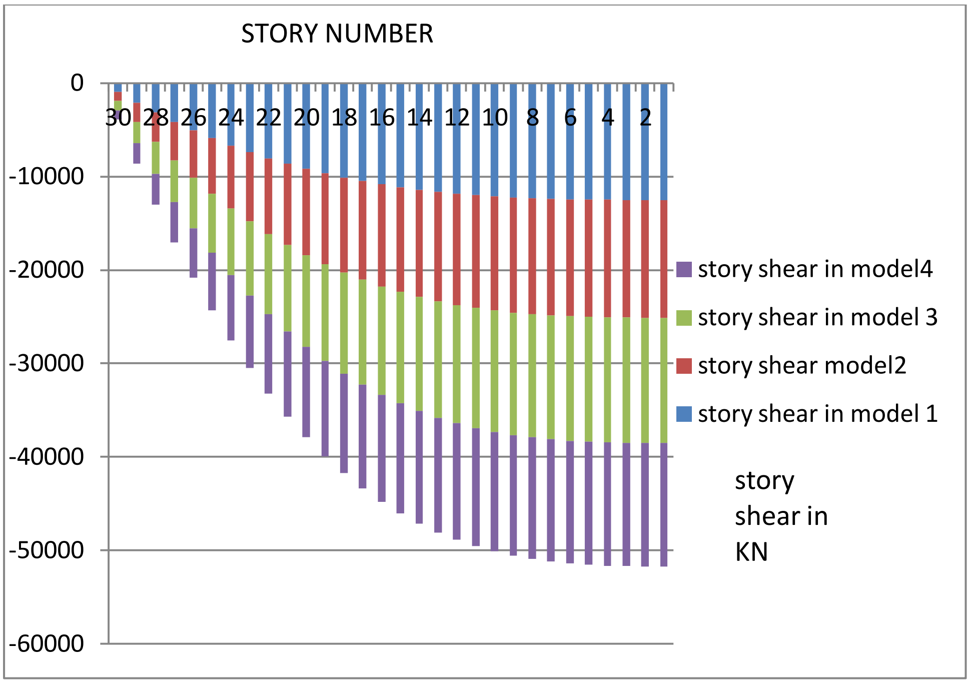

STORY NUMBER
0
-10000
-20000
-30000
-40000
-50000
-60000
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
story shear in model4
story shear in model 3
story shear model2
story shear in model 1
story shear in KN

Figure 33

CHAPTER 6

6.1Conclusion

In the present work a G+29 storey building was analyzed for seismic force. The different cases of the framed building were taken into consideration. Various cases of the building model have different location of shear wall. in model 3 shear wall is acting as a coupled shear wall which improves building performance based on earthquake loadings. Following conclusion may be drawn after the analysis

(1)When the stiffness of the building is increased, it is observed that the storey displacement in the respective direction decreases.

(2)The storey displacement in z-direction is observed to be increasing. The cause behind such behavior could be the decrease in the stiffness of the building in the z-direction.

(3)The base shear of the building goes on increasing as the stiffness of the framed building increases.

(4)The mass participation of the building is also affected. It increases in the x-direction, as the lateral stiffness for various cases of the building model goes on increasing in the x-direction.

(5)The peak storey shear is maximum at the first storey level, and it decreases with the storey number. It is observed that, as the stiffness of the building model increases, it attracts more seismic forces, hence the storey shear in a particular storey shows an increasing trend.

6.2 Scope of work

Following may be the scope of future work-

(1) The analysis of a regular structure could also be done . comparison could be done to the change in response of the framed building with shear wall with respect to change in plane stiffness.

(2) Estimating an optimum location of shear wall in a structure, so that most economic design of the framed building with shear wall could be done from the seismic point of view.

(3) Contribution of infill plane stiffness to the framed structure with and without shear wall in the seismic condition could be another field of research.

(4) The future work in this research work includes the design of irregular home structures with a much refined analytical technique namely non-linear dynamic analysis. the time history method in which the elasto- plastic behaviour of the structural elements is taken into consideration