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LATERAL SEISMIC RESPONSE OF FRAMED STRUCTURE WITH SHEAR WALL

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ABSTRACT
The lateral response of framed structure can be improved by placing shear wall judiciously in the plan of the structure. Most of the residential building is un-symmetrical due to functional necessity. Nonlinear static analysis (Pushover Analysis) was carried out for high rise building in zone IV. The nonlinear static analysis gives a better understanding and more accurate seismic performance of buildings and the quantification of damage or failure at the element level. Nonlinear static pushover analysis results on the frame with and without shear wall is presented in this paper. The relationship curve between base shear and roof displacement of the structure and the demand curve for the zone IV region establishes the performance point. The provision of shear wall and the corresponding change in performance level are studied using SAP2000.

KEYWORDS: Pushover Analysis, RC Structure, Shear Wall.

INTRODUCTION

Pushover analysis in reinforced concrete structure is a non-linear static analysis method in which the structure is subjected to monotonically increasing lateral forces distributed along the height-of the building and evaluating the roof displacement for every step of loading. This is initially done as a force control push wherein the displacement is evaluated for the load applied. At nonlinear stage the analysis procedure is controlled by appled displacement and evaluates the corresponding load. Pushover analysis consists of a series of sequential elastic analysis, superimposed to approximate a force-displacement curve of the overall structure. A load-deformation diagram 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.

Placing of shear wall in RC structure gives sufficient strength and deformation capacity to resist the lateral load. The pushover analysis results are used to compare the seismic performance of framed system with shear wall and also to identify economical and more efficient way in resisting lateral seismic forces.

OBJECTIVE

1. To study the seismic performance of lateral force resisting system using pushover analysis.
2. Comparison of results to estimate the effective contribution of shear wall in overall.

LITERATURE REVIEW

D.N. Shinde,Nairetal. In their paper titled "Pushover Analysis of Multi Story Building",discussed about seismic response of RC building using pushover analysis with load corresponding to IS456:2000 and IS 1893:2002. The base shear is calculated and push X and Y curves given using sap2000.

K. SoniPriyaetal in their paper titkled "Non-linear Pushover Analysis of flatslab Building by using SAP2000" discussed about structural response of the building, obtained from pushover analysis on slabs, pushover curve and demand curved is analysed.

Achyut S. Naphade, Prof. G. R. Patil "Pushover Analysis of RCC Building With Soft Storey at Different Levels" is about seismic capacity of RC framed multi-storey buildings with soft storey, plastic hinge formation pattern and seismic performance of the building with shear wall.

Praveen Thakur, Dr. Suresh Kushwaha, PrabhatSoni "Comparative Analysis of Design Parameters for Multi-storied Framed Structure under Seismic Excitation" discussed about moment in Y direction in pushover analysis and compared to static and dynamic analysis.

AbhijeetBaikerikar, KanchanKanagali "Study of Lateral Load Resisting Systems of Variable Heights in all Soil Types of High Seismic Zone" is about lateral displacements, drifts, base shear, time period at variable heights for bare frame using response spectrum method in zone V for all types of soils.

METHODOLOGY

Nonlinear behavior is assumed to occur within a structure at concentrated plastic hinges. The default types include an uncoupled moment hinges, an uncoupled axial hinges, an uncoupled shear hinges and a coupled axial force and biaxial bending moment hinges.

Control node is the node used to monitor displacements of the structure. Its displacement versus the base-shear forms the capacity (pushover) curve of the structure. Developing the pushover curve which includes the evaluation of the force distribution along height and computing the lateral deformation at control point. . To have a displacement similar or close to the actual displacement due to earthquake, it is important to consider a force displacement equivalent to the expected distribution of the inertial forces. Different force distributions can be used to represent the earthquake load.

The structure is pushed to reach the demand displacement which represents the maximum expected displacement resulting from the earthquake intensity under consideration.

Performance evaluation is the main objective of a performance based design. A component or action is considered satisfactory if it meets a prescribed performance.

MODELLING

Table1. Description

Sl.no	Particulars	RCC Structure
1	Grade of Concrete	M30
2	Grade of Steel	Fe415
3	Density of Reinforced concrete	25 kN/m3
4	No. of Storey	G+5
5	Beam Size	0.3x0.45m
6	Column Size	0.3x0.3m
7	Slab thickness	0.2m
8	Shear wall thickness	0.4m
9	Wall thickness	0.25m
10	Height of all storey	3m
11	Seismic zone	IV
12	Soil type	Medium soil
13	Dead load	6.25 kN/m2
14	Live load	5 kN/m2

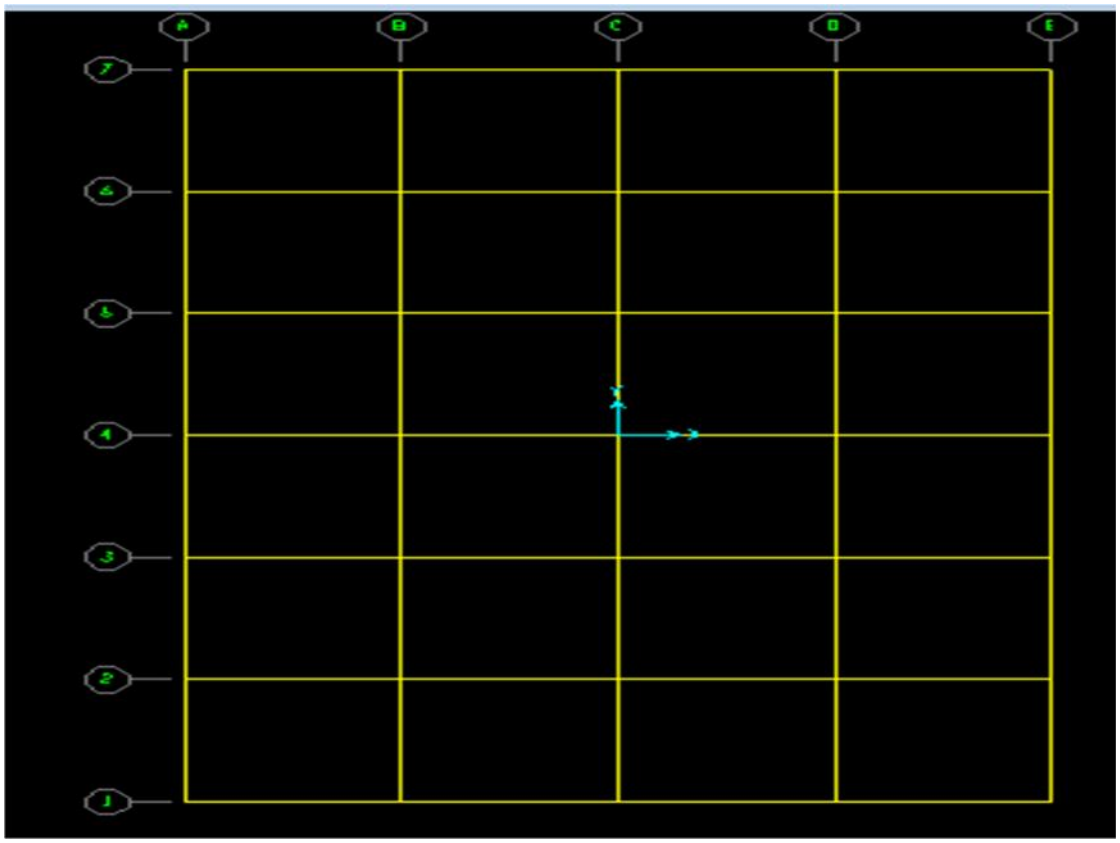

Fig.1 Building plan G+5

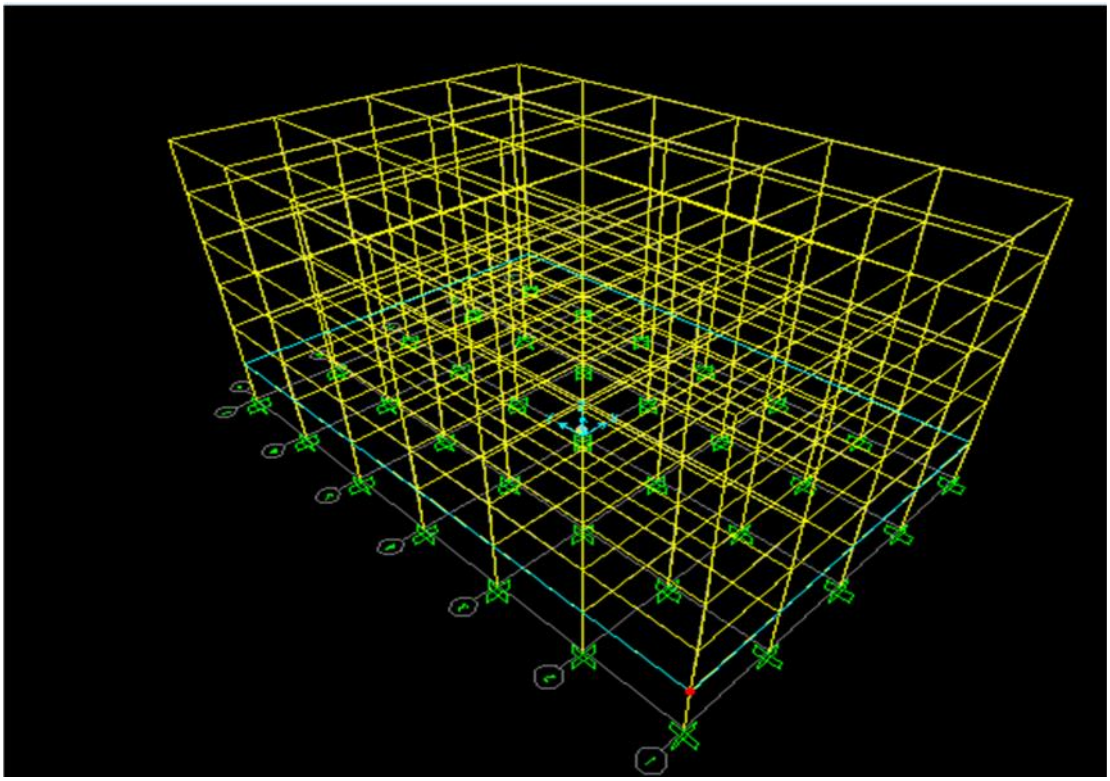

Fig2. Elevation

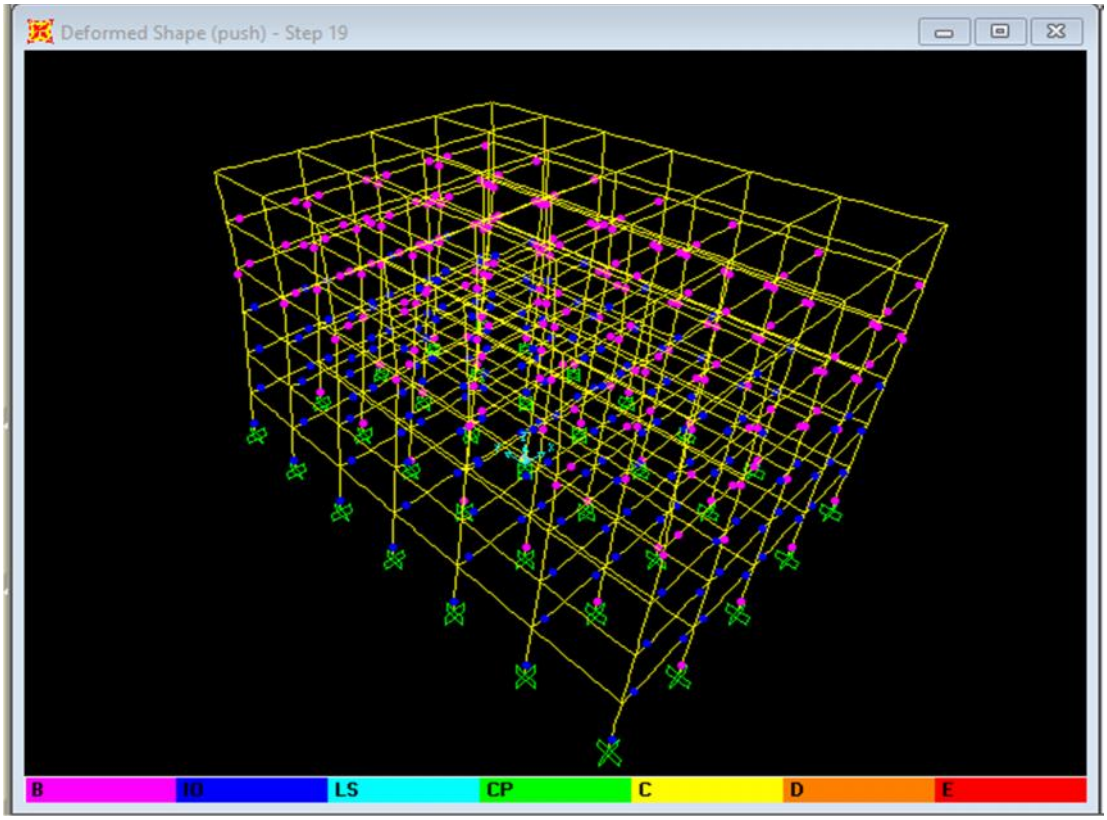

Fig 3.Formation of hinges from pushover

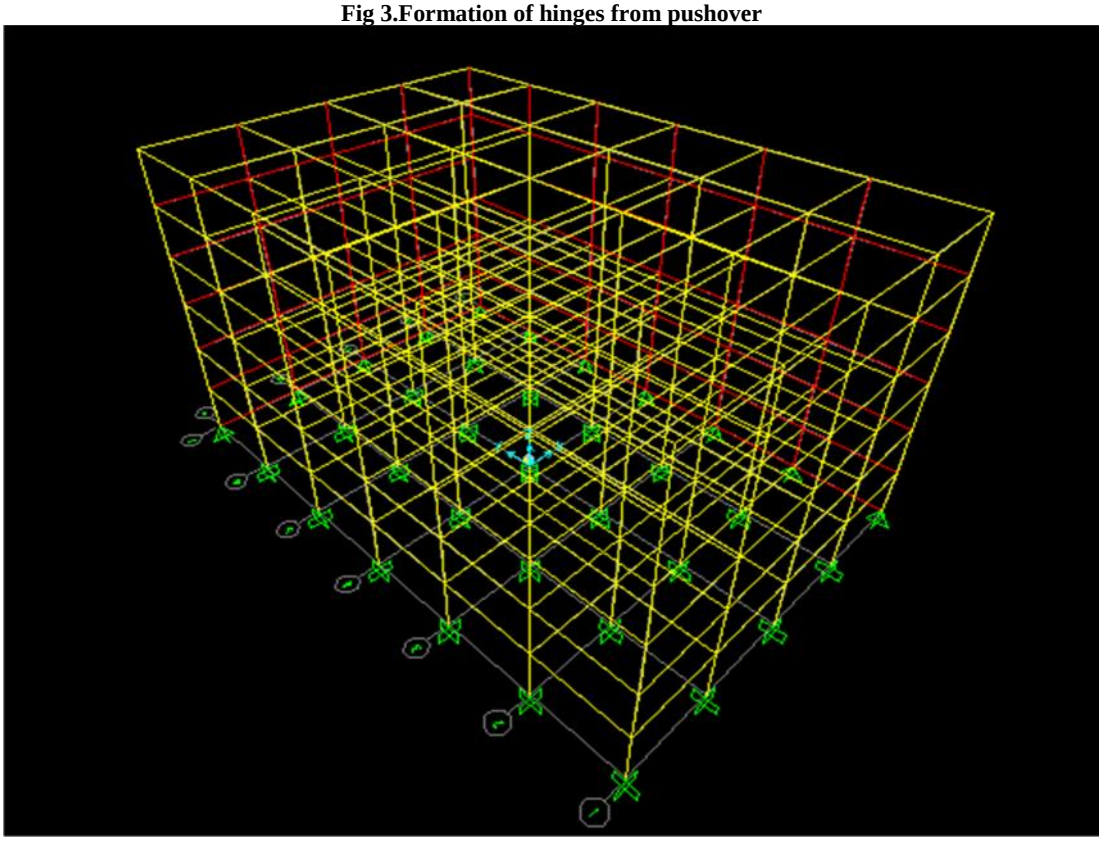

Fig 4. Structure with shear wall

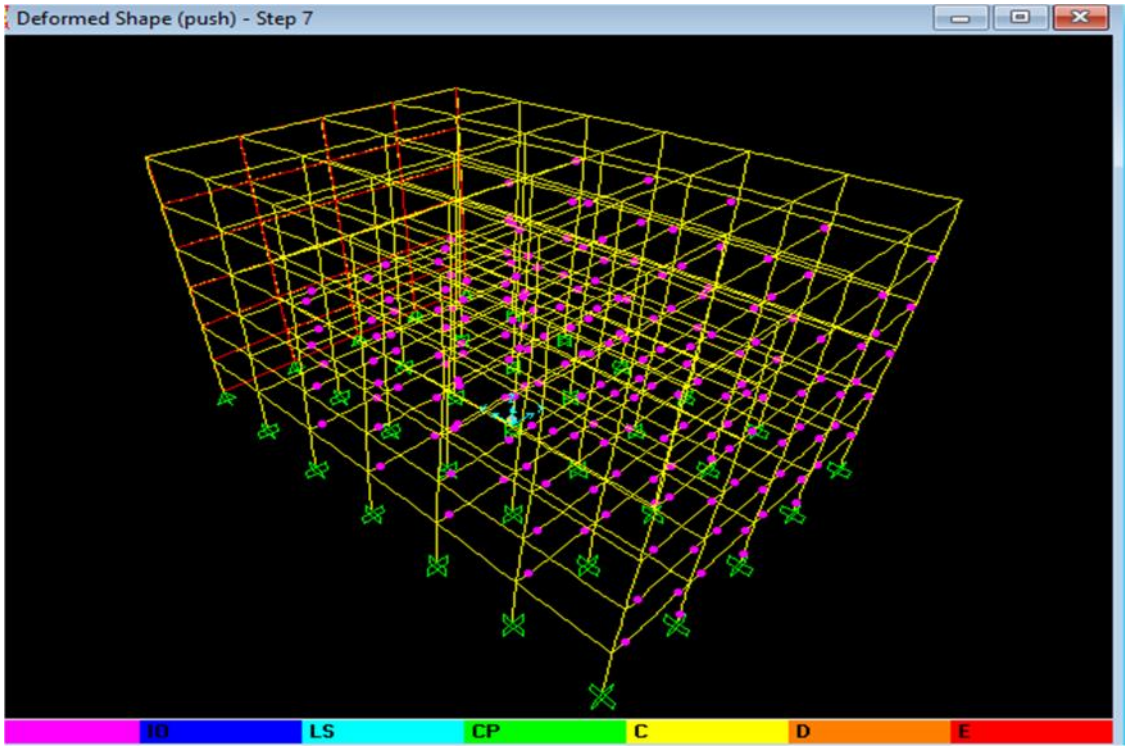

Fig 5.Formation of hinges with shear wall

Ground Floor (KN)	1st Floor(KN)	2nd Floor(KN)	3rd Floor(KN)	4th Floor(KN)	5th Floor(KN)
900	1800	1800	1800	1800	900

Table2. Seismic weight of G+5

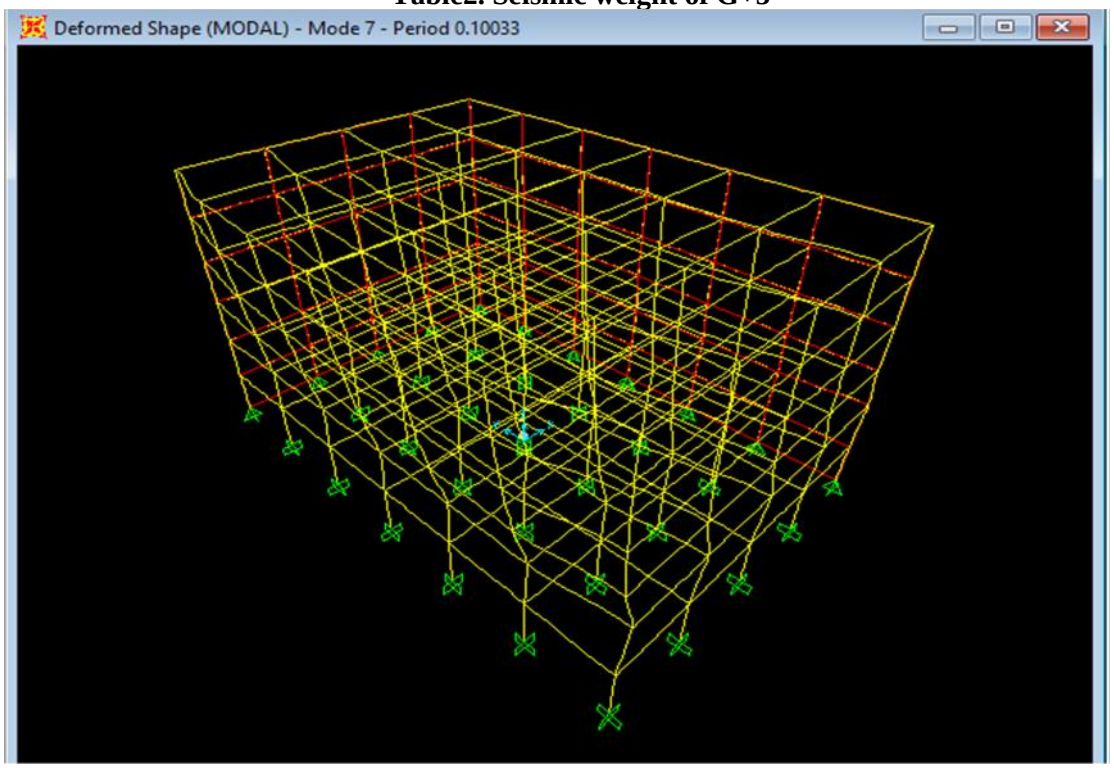

Fig6. Deformed shape with shear wall

RESULTS AND DISCUSSION

The seismic weight is calculated for each floor.The base shear is calculated according IS 1893: 2002.Pushover analysis is done for boththe frame with shear wall and without shear wall and the resultsares compared. Table 3 and 4 gives the results of roof displacement for various base shear forces.

Table3. Displacement and base shear in pushover

STEP	DISPLACEMENT	BASE FORCE
0	5.78E-18	0
1	0.010911	526.746
2	0.014489	667.437
3	0.017203	731.266
4	0.018926	754.496
5	0.019275	757.301
6	0.036341	826.506

Table4. Displacement and base shear in pushover analysis with shear wall

Step	Displacement	Base shear force
0	0.000008948	0
1	0.004959	7766.282
2	0.009907	15533.592
3	-0.000494	-821.972

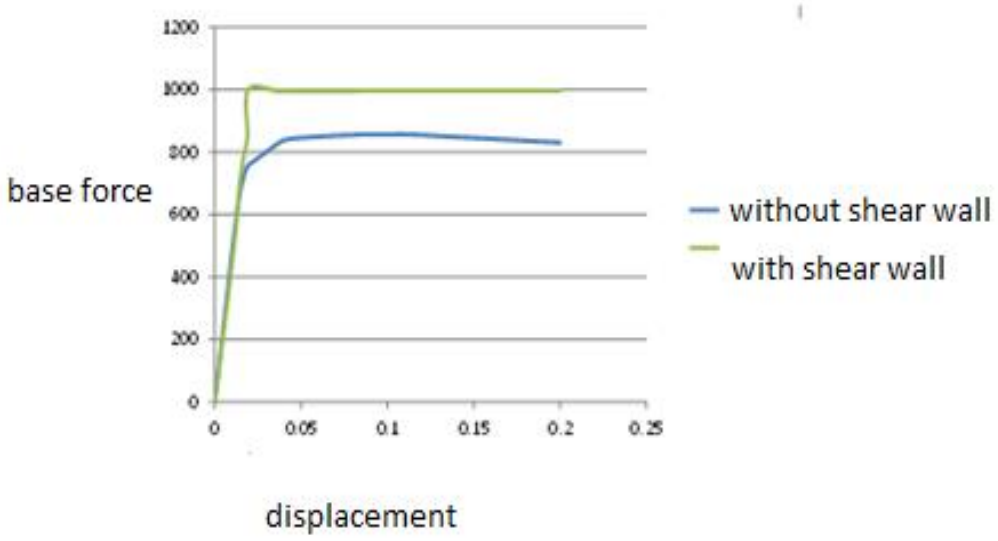

Figure7. Performance of the RC structure (with and without shear wall)

CONCLUSIONS

1. It can be seen from Table 3 and 4 and from Figure 7 that there is large reduction in shear force and the corresponding displacement when shear wall is introduced in the frame.

2. The deformation obtained from push over analysis with shear wall is less than that obtained for frame without shear wall.

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