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COMPARATIVE PERFORMANCE EVALUATION OF UNREINFORCED MASONRY (URM) INFILLED RC FRAMES SUBJECTED TO VARIOUS GROUND MOTIONS USING ETABS AS A TOOL

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ABSTRACT:

Now a day's construction of RC frame structure is common due to the simplicity in construction. Unreinforced Masonry infill walls (URM) tend to be utilised as interior and external partition walls in reinforced concrete (RC) framed constructions. Instead of being utilised for structural purposes, infill walls are often employed for partitioning and insulation. However, during an earthquake, this infill helps the structure respond, and the infill frame building behaves differently from a traditional frame construction. Infill functions between a column and a beam as a compression strut. For this reason, a linear dynamic analysis of an RC frame structure with masonry infill was carried out in order to determine the impact of the structure's strength variations with and without the infill wall as well as the impact of the infill on dynamic parameters such as story displacement, story drift, story shear, hinge status, target displacement, and performance point. The programme ETABS is used as a tool to do all of the analysis and modelling for the G+15 RCC framed construction.

Keywords: Structural Analysis, Pushover Analysis, maximum storey displacement, Infill walls, Displacement, Storey drift, Stability.

I. INTRODUCTION

For structural or aesthetic reasons, brick infills are used in the construction of many structures. However, the combination of brick infill panels is frequently disregarded in the non-linear evaluation of building structures due to the intricacy of the issue and the lack of a realistic, but straightforward analytical model. Such a presumption might result in significant errors when forecasting the structure's lateral stiffness, strength, and ductility. In the last four decades, there has been a lot of research done on the behaviour of masonry-infilled frames in an effort to create a logical design process. Because of the principle of cautious design, infill walls' strength and stiffness are often overlooked in Indian design practises. Practically speaking, infill walls provide the structure a significant amount of strength and stiffness, and their absence might lead to the collapse of many multi-story structures. Infills provide a considerable contribution to the resistance of lateral loads but not to the resistance of gravity loads. In reality, infill stiffness is often disregarded in frame analysis, which underestimates stiffness & natural frequency. The energy dissipation properties of infills help them be more seismically resistant. Numerous researchers have examined the behaviour of infill walls by varying a variety of structural analysis as well as civil engineering parameters and verticals, such as the percentage of infill openings, the presence or absence of infills, the opening of the first floor, the infill material, the analysis using various software programmes in conjunction with various analytical techniques, etc.

When there are structural defects in the horizontal load-bearing frames of a multi-story framework construction, earthquake damage often begins there. The organisation of mass, stiffness, and strength in both the vertical and horizontal lines of buildings determines how multi-storey framework constructions behave during strong seismic movements. Recent earthquakes, including the 2015 Nepal earthquake, in which multiple reinforced concrete structures were seriously damaged or toppled, have raised the idea that existing structures should be evaluated for their seismic compatibility. When there are structural defects in the horizontal load-bearing frames of a multi-story framework construction, earthquake damage often begins there. The mass distribution, stiffness, and strength in both the horizontal and vertical axis of buildings are key factors in how multi-story framework structures respond to significant seismic disturbances.

To analyse the skyscraper by retrofitting methods four models are developed as follows

Model I: RC Conventional Framed Structure

A reinforced concrete (RC) framed structure is a common type of building construction that utilizes reinforced concrete members, such as columns, beams, and slabs, to provide structural support and stability. RC framed structures are widely used due to their strength, durability, and versatility. The combination of reinforced concrete and steel reinforcement provides stability and resilience, making them suitable for a variety of building types and applications. Proper design, construction, and maintenance practices are essential for ensuring the longevity and safety of RC framed structures. The combination of steel reinforcement and concrete offers strength, durability, and flexibility, making RC framed structures widely used in residential, commercial, and industrial buildings.

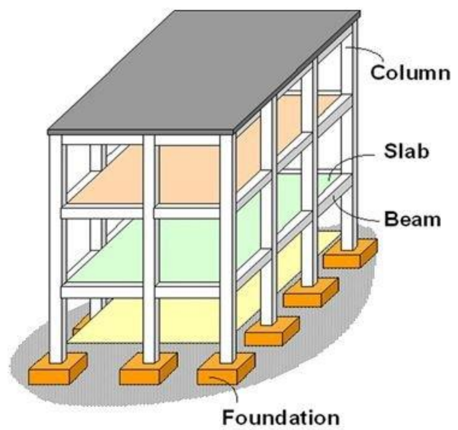


Fig.1 RC Conventional structure

Model II: URM wall Structure

A masonry wall that is erected inside of a structural frame, usually composed of reinforced concrete or steel, is referred to as an unreinforced masonry infilled wall. Non-structural features of the infilled wall include partitioning internal areas and enclosing the building exterior. The brick wall used in this construction approach is not intended to support any sizable lateral or vertical loads. Instead, it depends on the nearby structural framework to provide it the support and stability it needs. In essence, the infilled wall serves as a cladding / partition wall. It is important to highlight that the ability of unreinforced masonry infilled walls to withstand lateral or seismic stresses is limited. These walls may be susceptible to damage or collapse during earthquakes or strong wind events due to the absence of reinforcing in the brickwork. This is due to masonry's fragility and lack of considerable tensile strength.

These techniques improve the building's overall safety and structural integrity by reducing the susceptibility of unreinforced masonry infilled walls against seismic and lateral pressures. When developing or retrofitting such walls, it is essential to work with structural experts and comply to local building norms and regulations to guarantee correct construction & adherence to safety requirements. Below is a picture of a structure with a URM wall.

Fig.2 URM wall Structure

II. LITERATURE REVIEW

RC Frame using Brick Masonry Infill Walls Seismic Evaluation. Scholar in M.Tech Nitesh Singh and Associate Professor V.K. Verma Only as exterior walls and partition walls in RC frame structures are infill panels employed. These are regarded as non-structural features and may provide the structure a significant amount of stiffness, which enhances how well it responds to underground vibrations. In this study, the Equivalent Lateral Force technique and the Response Spectrum technique are utilised to analyse the behaviour of infill walls. One without infill and one with infill are regarded as two models. Using the Hendry formula, the one with the infill has been modelled as an analogous diagonal strut element. The Pushover analysis is used to analyse both models. STAAD Pro is the programme utilised, and the findings are contrasted with a bare frame with regard to of strength and stiffness.[1]

AAC & conventional brick infill walls' effects on the seismic performance of RC-framed structures are compared. Student of M.Tech Kajal Goel The investigation of an RC frame with two distinct infill materials—AAC (Autoclaved Aerated Concrete) and conventional concrete blocks—is the subject of this article. STAAD Pro was utilised for analysis in this article. Equivalent Static Force Analysis is the approach utilised in this article. This article compares the two materials using several characteristics, including base shear, end displacement, and frame deflection.[2]

Positive Effect of Masonry Infill Walls on RC Frame Building's Seismic Performance Sudhir K Jain and C V R Murty. Masonry infills significantly increase lateral stiffness, strength, overall ductility, and capacity for releasing energy. It is feasible to enhance the out-of-plane response of such infills by making appropriate arrangements for reinforcement in masonry that is securely fastened to frame columns. Infills prevent the RC frame from deforming laterally; they separate along one diagonal while compression struts develop along another. Infills provide the building more lateral rigidity as a result.[3]

Effect of Infill Stiffness on Indian Multi-Storey RC Framed Buildings' Seismic Performance. Devdas MENON, Meher, Praseetha KRISHNAN, Robin DAVIS PRASAD In India, brick masonry serves as the infill for the majority of reinforced concrete-framed multi-story structures. Unreinforced masonry infill walls won't necessarily help the structure withstand gravity loads, but they may greatly improve the structure's stiffness and strength in the event of an earthquake or a windstorm, which might lead to an underestimation of the structure's stiffness and natural frequency. Experiments have shown that infills have dissipation of energy qualities that help to increase earthquake resistance. In this essay, two typical structures in India's moderate seismic regions are taken into consideration. The distinction between two buildings is that one has a symmetrical design while the other has a layout with vertical irregularity (soft-storey). Modelling of the infills was done using an analogous strut technique. In order to assign the hinge characteristics to the beam and column sections, static analysis (for gravity alongside lateral loads), reaction spectrum analysis, and non-linear pushover analysis were carried out. When infill stiffness is taken into account, it is shown that the seismic demand at the soft storey level is substantially higher, with bigger base shear and larger displacements. However, in the symmetric building (without soft story), this impact is not observed to be substantial. The pushover analysis was used to compare the seismic performance of the two examples. This publication provides a thorough description of the findings.[4]

Highrise Building Earthquake Analysis with and Without Infill Walls. M.R. Wakchaure and S.P. Ped
It is well known that stone infill panels affect how RC frames react to seismic activity. This effect has been the focus of countless experimental research, and there have also been multiple efforts to model it analytically. In the study of structures, infill walls are modelled as comparable strut approaches; numerous equations for strut width and modelling have been developed by researchers and scientists. The infill acts as a compression strut between the column and the beam, transferring compression forces from one node to another. This research examines the impact of brick walls on tall buildings. On a high rise building with various arrangements, linear dynamic analysis is done. A G+9 R.C.C.-framed building is modelled for the study. The models are applied to the earthquake time history. The comparable strut technique is used to determine the strut's width. Numerous analysis instances are chosen. The analysis is done entirely by the programme ETABS. For all models, base shear, storey displacement, and story drift are computed and compared. The findings demonstrate that infill walls enhance base shear while decreasing displacements and time periods. Therefore, it is crucial to take into account the impact of masonry infill when evaluating a moment-resisting reinforced concrete frame for seismic activity.[5]

III. METHODOLOGY

Technique for study purpose various soil circumstances whichever is provided in IS456 in use in ETABS program. According to IS456 the Light, Medium, Rigid Strata with Variable base supports Based on movement and weight relation optimum construction were determined.

Modelling of Structural Systems

Basic to ETABS planning is the assumption that multi-story structures usually comprise of the same or comparable floor layouts that recur in the vertical position. Planning characteristics that simplify analytical-model creation, and mimic sophisticated earthquake systems, are enumerated as follows:

- Customized section shape and intrinsic behaviour
- Grouping of frames as well as shell elements
- Link assignment for simulating isolators, dampers, and some other complex earthquake systems
- Nonlinear hinge specification
- Editing and task tools for plan, perspective, and 3D views

3.1. RESPONSE SPECTRUM ANALYSIS

In accordance with IS-1893:2002, the total sum of the modal masses of all modes taken into consideration for the analysis should be at least 90% of the overall seismic mass.

For structures without any horizontal plan irregularities, ASCE 7-05, a Guide for the Planning of Diaphragms, allows diaphragms of concrete slabs or concrete stuffed metal decks with a span-to-depth ratio of 3:1 to be idealised as rigid; otherwise, the structural evaluation shall expressly embody believed of the stiffness of the diaphragm without elaborating. Nasser et al. (1993), Mansur et al. (1999), and Abdalla and Kennedy (1988) provided information on how an opening in rectangular RC and prestressed beams impacts stress distributions and a concrete beam's capacity in the field of concrete beams having net openings. Sadly, there was little evidence that the theory was developed to include other configurations; it was just marked against readily available experimental findings.

3.2.PUSHOVER ANALYSIS:

Buildings sustain crucial inelastic deformation under a powerful earthquake and dynamic characteristics of the structure evolve over time, so analyzing the implementation of a structure needs inelastic science methods depicting these dynamics. Inelastic analytical techniques grasp the people knows of structures by identifying letdown modes as well as the possibility for dynamic breakdown. Inelastic analysis techniques essentially combine inelastic analysis of time history as well as inelastic data observed that would otherwise be called pushover analysis.

The elastic - plastic time history study is the most precise method to predict the force and displacement demands at various components of the construction. In any event, the employment of inelastic time history analysis has been limited in due to the fact that dynamic response is exceedingly sensitive to showing and ground movement qualities. Additionally, it needs accessibility of an array of deputy seismic ground records that tracks for disturbances and differences in severity, regularity and length of time characteristics.

In a sense, the modeling approach in anticipating earthquake requests should be explored for low, intermediate and high rise constructions by distinguishing certain concerns, for instance, demonstrating non - linear part conduct, algorithmic fully intend of a method, varieties in the prognostications of different horizontal responsibility designs used during customary pushover analysis, aptitude of conserved parallel burden designs in talking to wave propagation impacts and precise assessment of target upending during which seismic interest assumption of pushover technique is conducted.

3.3.OBJECTIVES OF STUDY

A thorough literature study is carried outside to describe the goals of the thesis. The literature survey is reviewed and quickly outlined as follows:

1. To decide the capacity of URM infilled wall structure compared to conventional reinforced concrete structure as a parallel load opposing individuals.
2. Dynamic investigation of the tall framed structures considering response spectrum examination.
3. Utilization of Advanced diagnostic applications of software like Staad.Pro, Etabs for story response plot examination of horizontal load opposing structure and the inter story displacements.
4. To decide the capacity and dynamic investigation in the terms of maximum story displacement and story drift of the tall framed structure subjecting to IS load combinations.
5. To set up a reference study for the usage of URM infilled walls in the framed structures according code standards.

IV. BUILDING MODELLING AND ANALYSIS

For a analysis in ETABS firstly select the material property in define then add the required material which we use in design of G+15 structure. By choosing define option material properties in this case, we had first specified the material property. By providing the necessary information in the defining tab, we introduced new material to make our structural elements (beams, columns, slab, and URM wall). Then, by choosing the frame sections shown below, we defined section size and added the necessary sections for beams, columns, etc.

Building type	G + 15
Plan dimensions	40 x 30 m
No. of bay in X direction	8 Bays
No. of bay in Y direction	6 Bays
Typical storey height	3.3 m
Bottom storey height	3.0 m
Building height	55.8 m
Soil type	Type II (Medium Soils) Combined or Isolated RCC footings with the beams
Design criteria	(As Height of building is greater than 40m up to 90m type) Analysis for all zones. Modal analysis using Response spectrum method and for performance Time history or Push-over analysis is to be performed for the maximum deformed zone.
Zone considering	II, III, IV & V
Importance Factor, I	1
Response Reduction Factor, R	5 (SMRF) RC Building with Special Moment Resisting Frame
Performance factor, K	1.0 (Moment resistant frame with appropriate ductility details as given in IS: 437.6-1976* in reinforced concrete or steel)
Support condition of columns	Fixed

Table 1: Geometrical properties & location factors

Column size	450 x 600 mm
Beam size	300 x 450 mm

Thickness of slab	150 mm
Grade of concrete	M-40
Grade of steel	Fe-550
Column size	450 x 600 mm

Table 2: Section & material properties

Wall load on external beams	13.11 kN/m
Wall load on internal beams	8.55 kN/m
Floor finish load	1.5 kN/m^2
Live load on floor	2 kN/m^2
Terrace finish load	1.5 kN/m^2
Dead load factor	1
Live load factor	0.25 (i.e., 25%)
Load combination considering live load	1.2[DL + IL ± (EL_X ± 0.3 EL_Y)] and 1.2[DL + IL ± (EL_Y ± 0.3 EL_X)] and

Table 3: Loading details

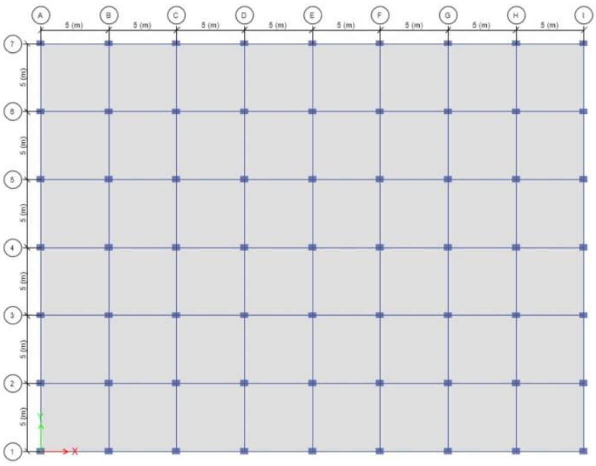


Fig 3. Plan Layout of structure

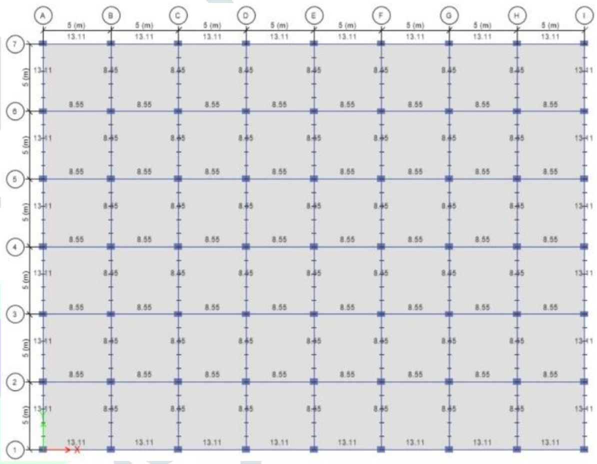


Fig 4. Dead Load on Beams

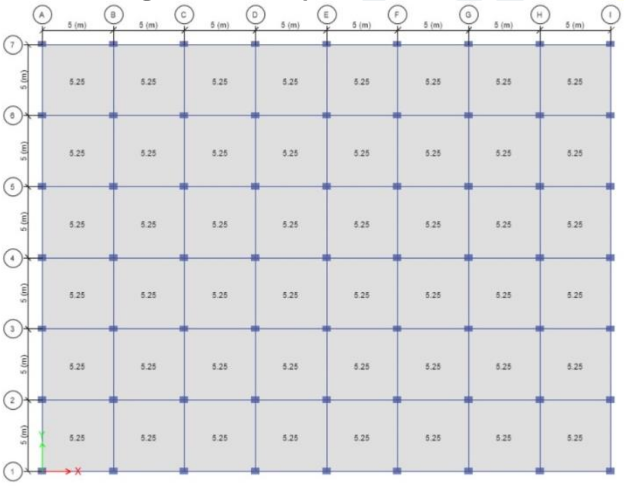


Fig 5. Dead Load on Slab

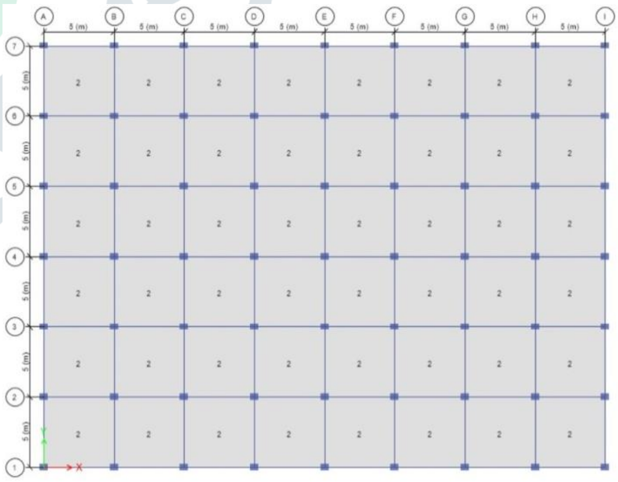


Fig 6. Live load on slab

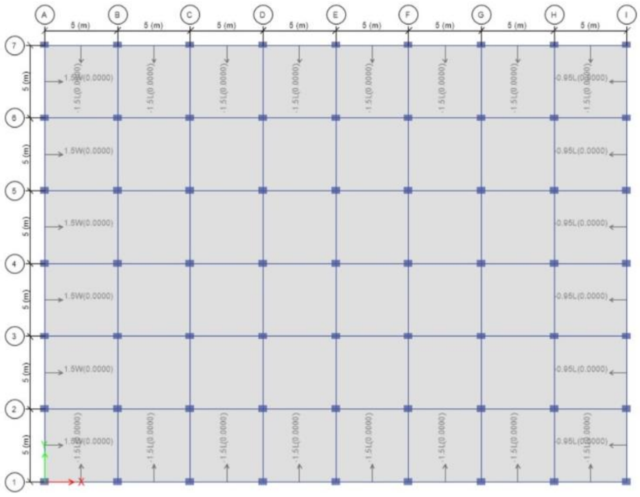


Fig 7.Wind pressure co-efficients of structure

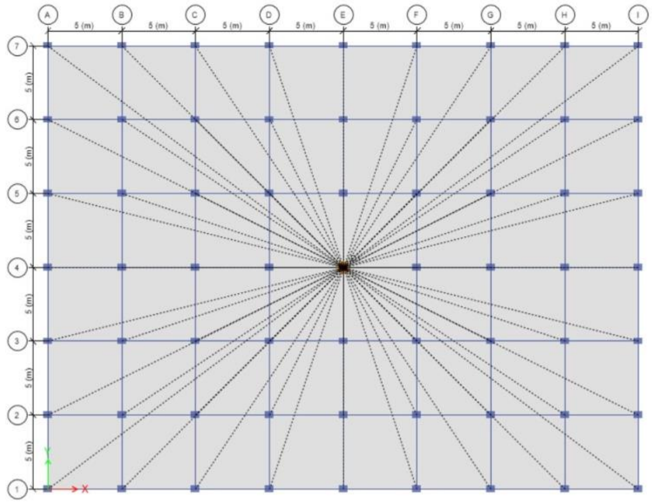


Fig 8. Diaphragm Properties

The output and display formats for moment, shear, and axial force diagrams as well as deformed shapes are available after assigning all the properties of beams, columns, and slabs and applying loads. These may be arranged into specialized reports and fine-grained section cuts showing different local response measures.

As per 7.9 clause of IS 1893(part 1):2016 for RC Buildings with Unreinforced Masonry Infill Walls

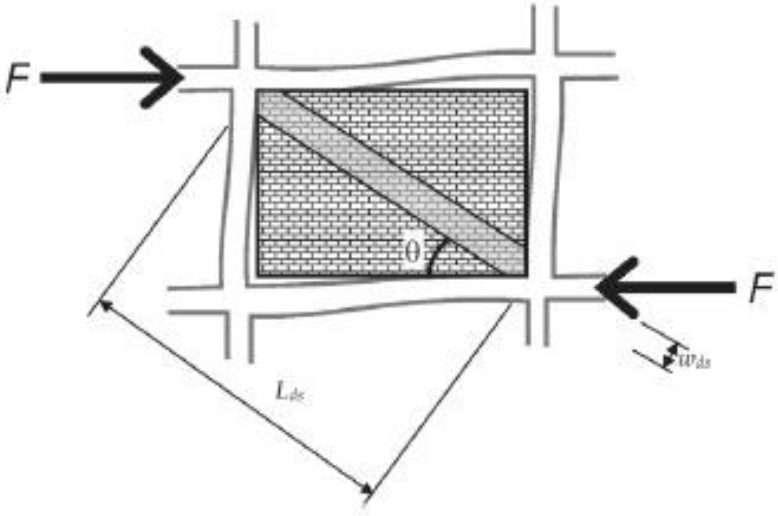


Fig 9. Equivalent Diagonal Strut of URM Infill Wall

Compressive strength of concrete $f_{ck} = 40\ N/mm^2$

Modulus of Elasticity $E_f = 5000\sqrt{f_{ck}} = 31622.777\ N/mm^2$

Compressive strength of brick $f_b = 10.5\ N/mm^2$

Compressive strength of mortar $f_{mo} = 53\ N/mm^2$ (as 53 grade cement is used widely)

Compressive strength of masonry prism $f_m = 0.433\ f_b^{0.64}\ f_{mo}^{0.36}$

$$f_m = 0.433\ (10.5)^{0.64}\ (53)^{0.36}$$

$$= 0.433 \times 4.504 \times 4.176$$

$$= 8.144\ N/mm^2$$

Modulus of elasticity of URM Infill wall $E_m = 550 f_m = 550 \times 8.144 = 4479.2\ N/mm^2$

Story Height = 3300 mm

Bay Length = 5000 mm

Column Size = 450x600 mm

Beam size = 300x450 mm

Height of Infill (h) = 3300-450 = 2850 mm

Length of Infill (l) = 5000-600 = 4400 mm
Thickness of Infill (t) = 230 mm
Moment of Inertia of adjoining column (I_c) = $\frac{450x600^3}{12}$ = 0.0081 m^4 = 81,00,000,000 mm4
θ= $\tan^{-1}\frac{h}{l}$ = $\tan^{-1}\frac{2850}{4400}$ = 32.932
L_{ds} = h/sin θ = 2850/sin32.932 = 5242.408 mm
Putting above values in the equation,
$\alpha_h = h\left(\sqrt[4]{\frac{E_m\, t\, sin2\theta}{4\, E_f\, I_c\, h}}\right) = 2850\left(\sqrt[4]{\frac{4479.2*230*\sin(2*32.932)}{4*31622.777*8100000000*2850}}\right) = 2.146$
$W_{ds} = 0.175\ \alpha_h^{-0.4}\ L_{ds}$
W_{ds} = 675.954 mm (taken 600 mm)
Thickness of URM infill wall taken as wall thickness i.e., 230 mm

From the above we have taken the dimensions of URM infill equivalent diagonal Of URM infill wall as 230 mm width to 600 mm as depth.

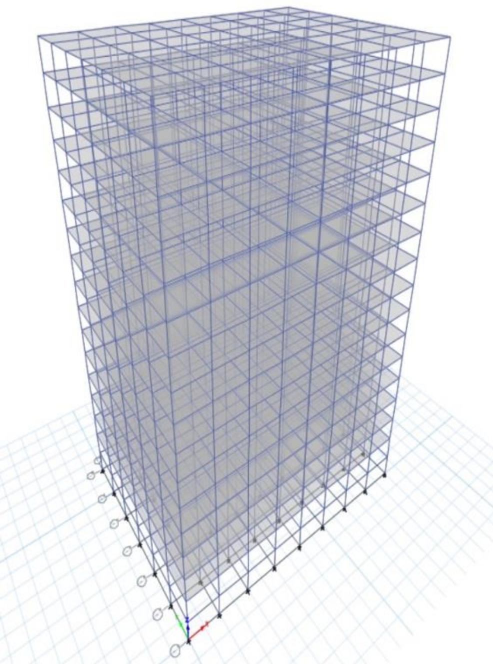


Fig 10. 3D view of Model I

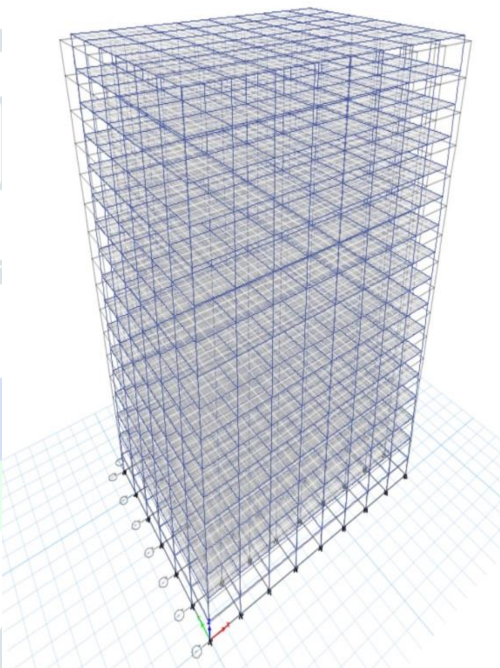


Fig 11. Deformation of Model I

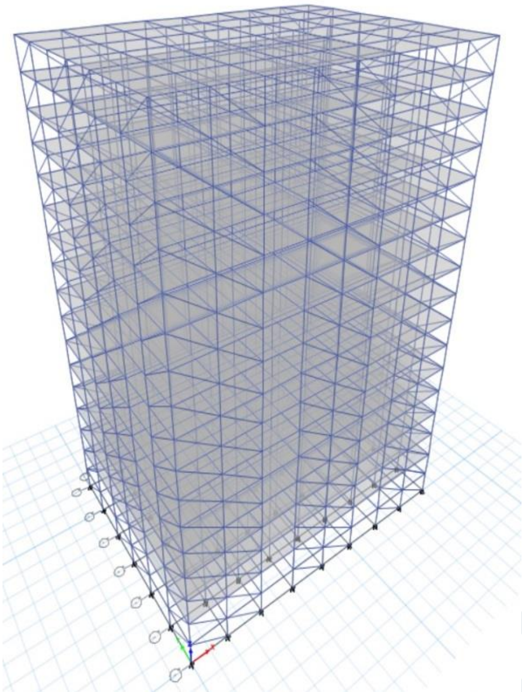


Fig 12. 3D View of Model II

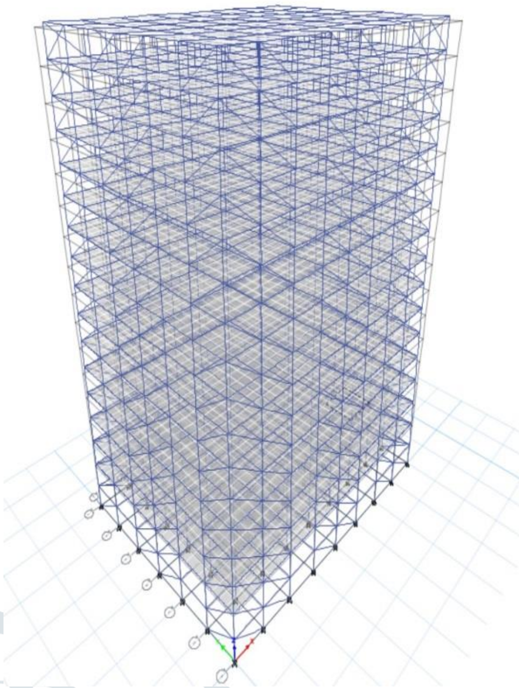


Fig 13. Deformation of Model II

V. RESULTS AND DISSCUSIONS

The chosen building model is reviewed through response spectrum analysis and load combination prescribed by the IS standards. The following are the terms in which the response spectrum results are presented in form of story response plots.

Maximum story Displacement: The tale's lateral displacement with respect to the base is referred to as story displacement. The excessive lateral movement of the building may be controlled by the lateral force-resisting system.

Maximum story Drift: Story drift is calculated by dividing the distance between two adjacent stories by the height of each story.

Maximum story Shear: The total of the lateral pressures exerted at each level of the structure is the maximum story shear. As floor forces are added from the top to the bottom of the building to determine cumulative story shears, they should increase as you descend.

5.1. RESULTS FROM RESPONSE SPECTRUM ANALYSIS - RC CONVENTIONAL STRUCTURE

5.1.1. MAXIMUM STORY DISPLACEMENT – RC CONVENTIONAL STRUCTURE

STORY	ZONE II (mm)	ZONE III (mm)	ZONE IV (mm)	ZONE V (mm)
Story 15	16.091	25.745	38.618	57.926
Story 14	15.847	25.355	38.033	57.049
Story 13	15.478	24.765	37.147	55.721
Story 12	14.988	23.981	35.971	53.957
Story 11	14.388	23.021	34.531	51.796
Story 10	13.686	21.898	32.847	49.27
Story 9	12.89	20.624	30.935	46.403
Story 8	12.005	19.209	28.813	43.219
Story 7	11.039	17.662	26.494	39.74
Story 6	9.995	15.993	23.989	35.984
Story 5	8.879	14.206	21.31	31.964
Story 4	7.695	12.311	18.467	27.7
Story 3	6.446	10.313	15.469	23.204
Story 2	5.132	8.212	12.318	18.476
Story 1	3.753	6.005	9.007	13.511
Ground Floor	2.311	3.698	5.547	8.321
Plinth Level	0.832	1.331	1.997	2.995
Column Base	0	0	0	0

Table 4. Maximum Story Displacement of Structure

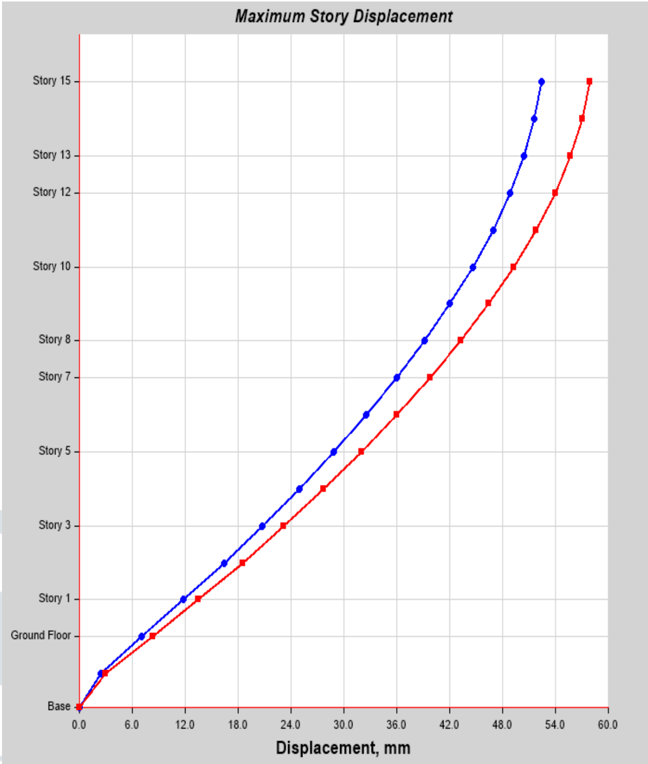


Fig 14. Maximum Story Displacement of Model I

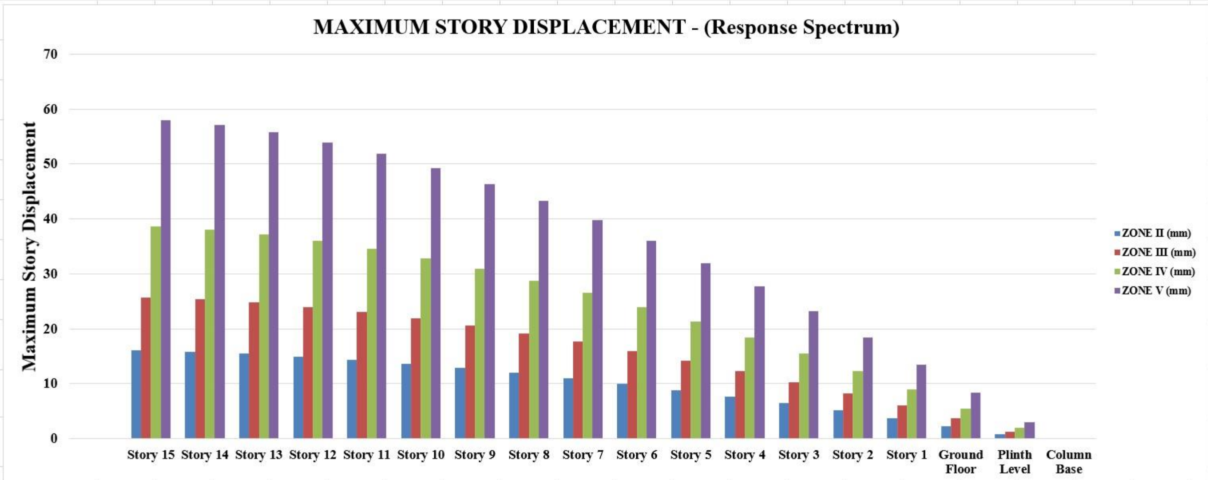


Fig 15. Comparison graph of Maximum Story Displacement

5.1.2. MAXIMUM STORY DRIFT- RC CONVENTIONAL STRUCTURE

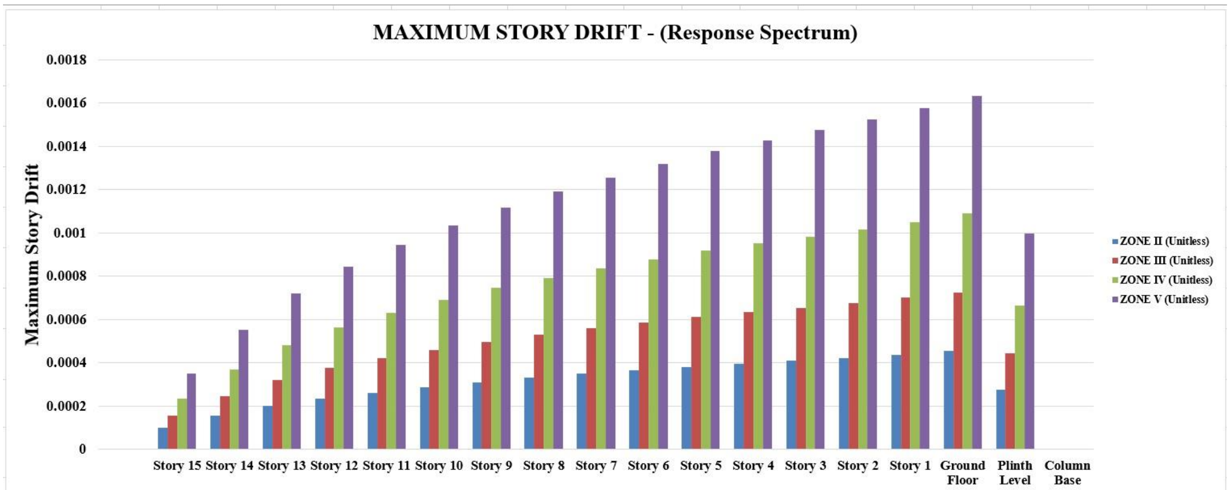


Fig 16. Comparison graph of Maximum Story Drift

STORY	ZONE II (Unitless)	ZONE III (Unitless)	ZONE IV (Unitless)	ZONE V (Unitless)
Story 15	0.000098	0.000156	0.000234	0.000351
Story 14	0.000154	0.000246	0.000369	0.000553
Story 13	0.0002	0.00032	0.00048	0.00072
Story 12	0.000235	0.000376	0.000563	0.000845
Story 11	0.000262	0.00042	0.00063	0.000945
Story 10	0.000287	0.00046	0.00069	0.001035
Story 9	0.00031	0.000496	0.000745	0.001117
Story 8	0.00033	0.000529	0.000793	0.00119
Story 7	0.000349	0.000558	0.000837	0.001255
Story 6	0.000366	0.000586	0.000879	0.001318
Story 5	0.000382	0.000612	0.000918	0.001377
Story 4	0.000397	0.000635	0.000952	0.001428
Story 3	0.000409	0.000655	0.000982	0.001474
Story 2	0.000423	0.000677	0.001015	0.001523
Story 1	0.000438	0.000701	0.001051	0.001577
Ground Floor	0.000454	0.000726	0.001089	0.001634
Plinth Level	0.000277	0.000444	0.000666	0.000998
Column Base	0	0	0	0

Table 5. Maximum Story Drift of Structure

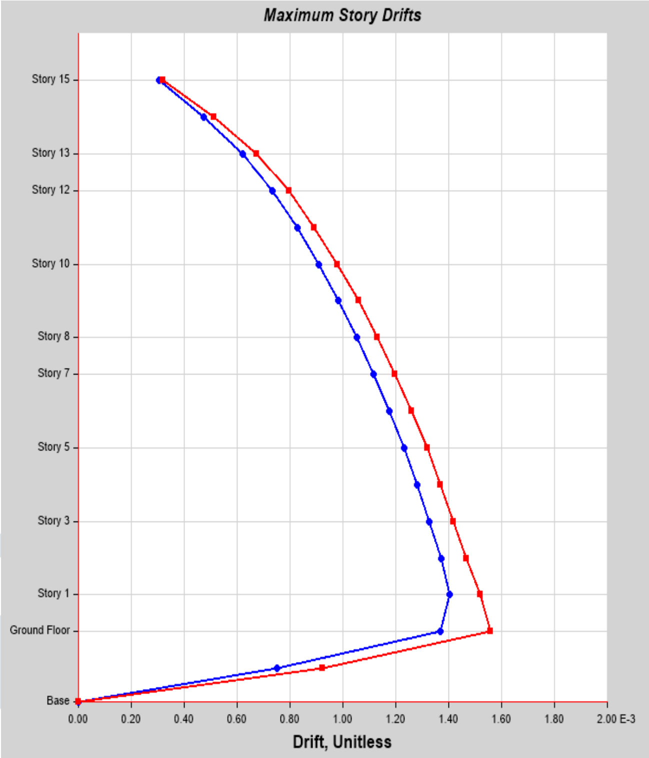


Fig 17. Maximum Story Drift of Model I

5.1.3. MAXIMUM STORY SHEAR - RC CONVENTIONAL STRUCTURE

STORY	ZONE II (kN)	ZONE III (kN)	ZONE IV (kN)	ZONE V (kN)
Story 15	193.2072	309.1315	463.6972	695.5458
Story 14	360.3674	576.5879	864.8818	1297.3227
Story 13	484.8545	775.7672	1163.6508	1745.4762
Story 12	573.3483	917.3573	1376.0359	2064.0539
Story 11	643.3563	1029.3701	1544.0551	2316.0826
Story 10	708.2148	1133.1437	1699.7155	2549.5733
Story 9	769.9994	1231.999	1847.9985	2771.9977
Story 8	826.6426	1322.6281	1983.9421	2975.9132
Story 7	879.4551	1407.1281	2110.6922	3166.0383
Story 6	930.7513	1489.202	2233.8031	3350.7046
Story 5	978.9075	1566.252	2349.378	3524.0669
Story 4	1021.362	1634.1793	2451.2689	3676.9034
Story 3	1061.5909	1698.5455	2547.8182	3821.7273
Story 2	1107.327	1771.7232	2657.5848	3986.3772
Story 1	1158.6071	1853.7714	2780.6571	4170.9857
Ground Floor	1201.4284	1922.2855	2883.4283	4325.1424
Plinth Level	1208.502	1933.6033	2900.4049	4350.6073
Column Base	0	0	0	0

Table 6. Maximum Story Displacement of Structure

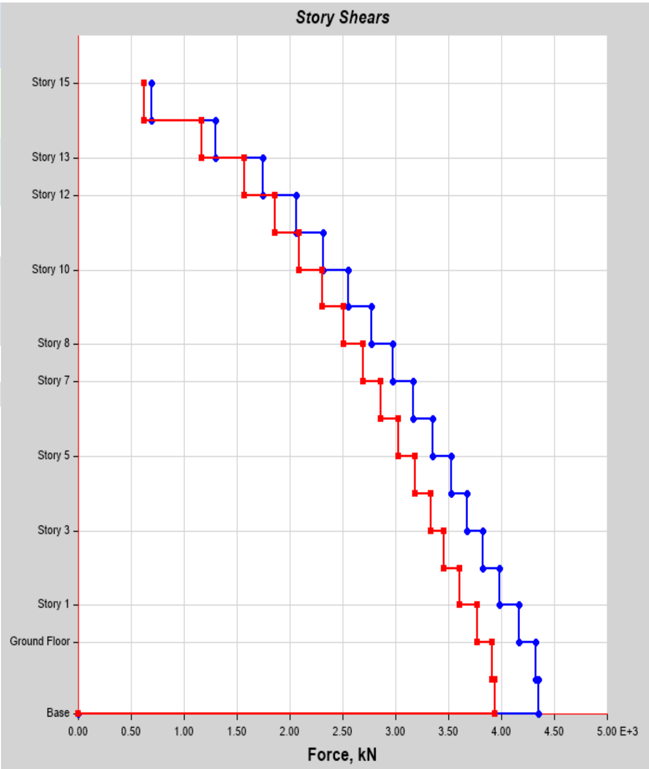


Fig 18. Maximum Story Displacement of Model I

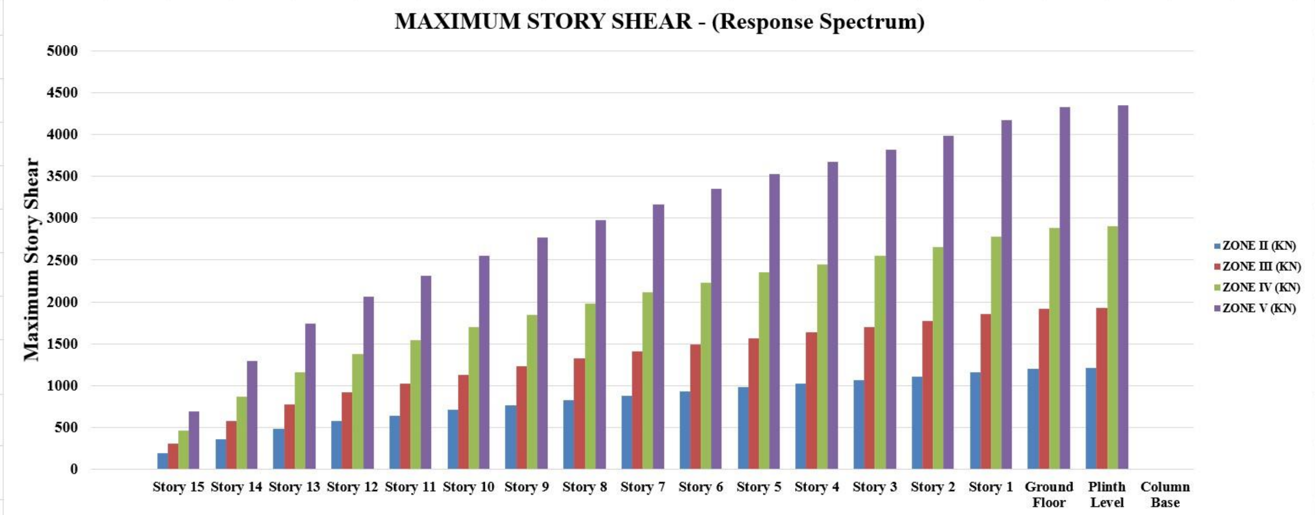


Fig 19. Comparison graph of Maximum Story Displacement

5.1. RESULTS FROM RESPONSE SPECTRUM ANALYSIS – URM INFILL STRUCTURE

5.1.1. MAXIMUM STORY DISPLACEMENT – URM INFILL STRUCTURE

STORY	ZONE II (mm)	ZONE III (mm)	ZONE IV (mm)	ZONE V (mm)
Story 15	11.984	19.175	28.762	43.143
Story 14	11.459	18.335	27.503	41.254
Story 13	10.879	17.407	26.11	39.166
Story 12	10.258	16.412	24.618	36.927
Story 11	9.597	15.354	23.032	34.548
Story 10	8.9	14.24	21.36	32.04
Story 9	8.172	13.075	19.612	29.419
Story 8	7.416	11.865	17.798	26.697
Story 7	6.636	10.617	15.926	23.889
Story 6	5.837	9.339	14.008	21.012
Story 5	5.024	8.039	12.058	18.087
Story 4	4.206	6.729	10.093	15.14
Story 3	3.39	5.424	8.136	12.204
Story 2	2.59	4.144	6.215	9.323
Story 1	1.823	2.917	4.375	6.563
Ground Floor	1.11	1.777	2.665	3.997
Plinth Level	0.576	0.921	1.382	2.073
Column Base	0	0	0	0

Table 7. Maximum Story Displacement of Structure

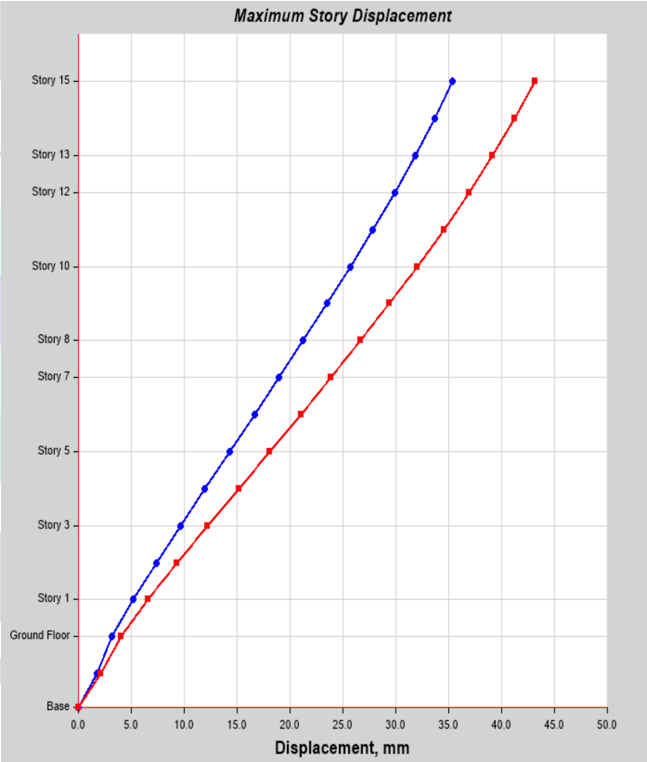


Fig 20. Maximum Story Displacement of Model I

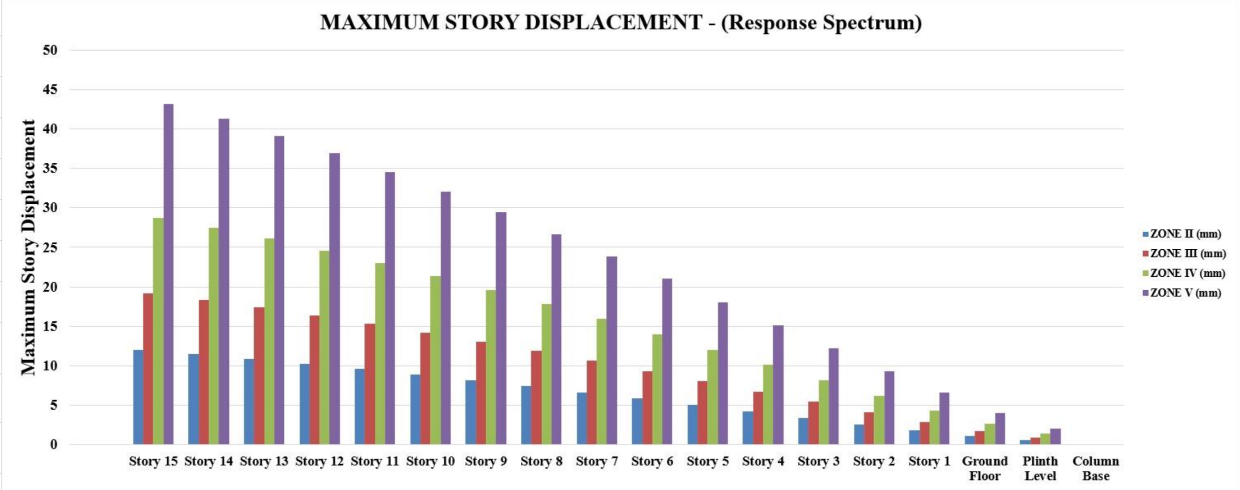


Fig 21. Comparison graph of Maximum Story Displacement

5.1.2. MAXIMUM STORY DRIFT- URM INFILL STRUCTURE

STORY	ZONE II (Unitless)	ZONE III (Unitless)	ZONE IV (Unitless)	ZONE V (Unitless)
Story 15	0.000175	0.000279	0.000419	0.000629
Story 14	0.000198	0.000316	0.000475	0.000712
Story 13	0.000215	0.000344	0.000516	0.000774
Story 12	0.00023	0.000367	0.000551	0.000826
Story 11	0.000241	0.000385	0.000578	0.000866
Story 10	0.000249	0.000398	0.000597	0.000896
Story 9	0.000255	0.000408	0.000611	0.000917
Story 8	0.000259	0.000414	0.000621	0.000931
Story 7	0.000261	0.000417	0.000626	0.000939
Story 6	0.000261	0.000418	0.000627	0.00094
Story 5	0.000259	0.000415	0.000622	0.000934
Story 4	0.000255	0.000408	0.000612	0.000918
Story 3	0.000247	0.000396	0.000593	0.00089
Story 2	0.000235	0.000376	0.000564	0.000845
Story 1	0.000217	0.000347	0.000521	0.000781
Ground Floor	0.000241	0.000386	0.000578	0.000868
Plinth Level	0.000192	0.000307	0.000461	0.000691
Column Base	0	0	0	0

Table 8. Maximum Story Drift of Structure

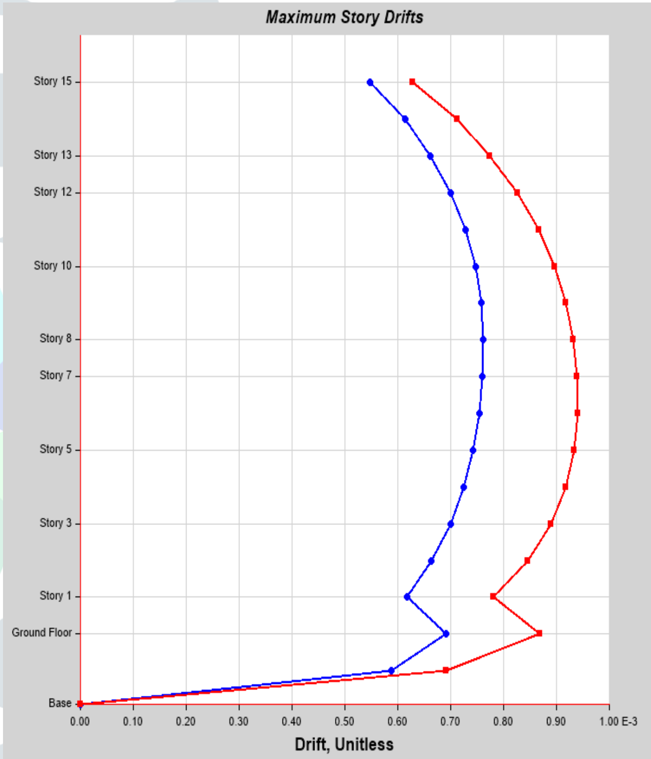


Fig 22. Maximum Story Drift of Model I

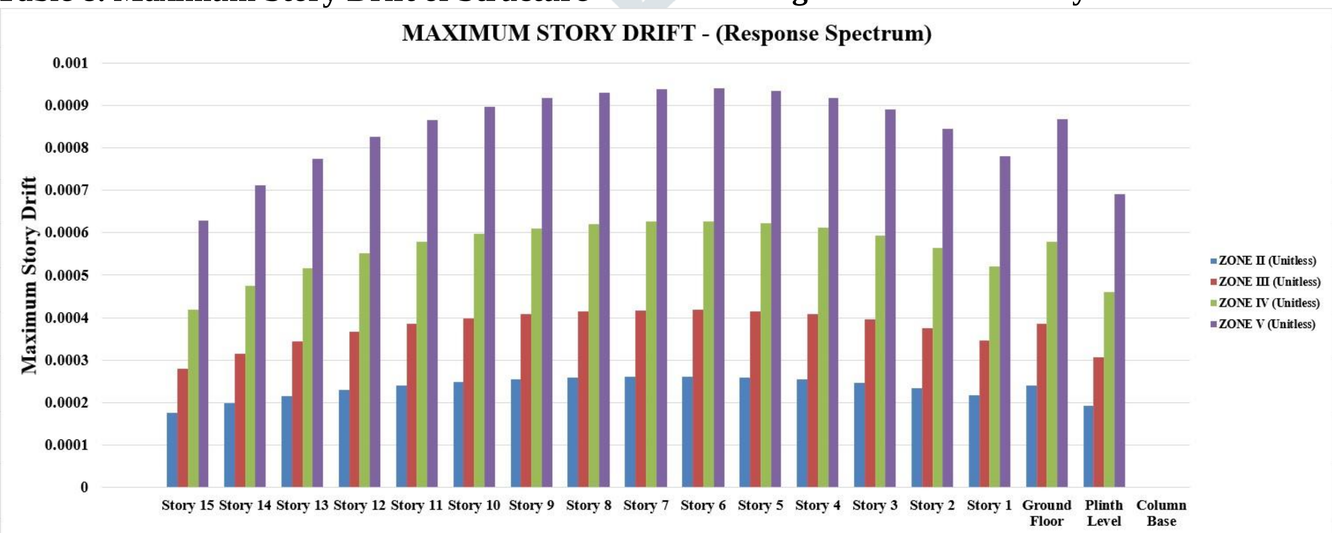


Fig 23. Comparison graph of Maximum Story Drift

5.1.3. MAXIMUM STORY SHEAR - URM INFILL STRUCTURE

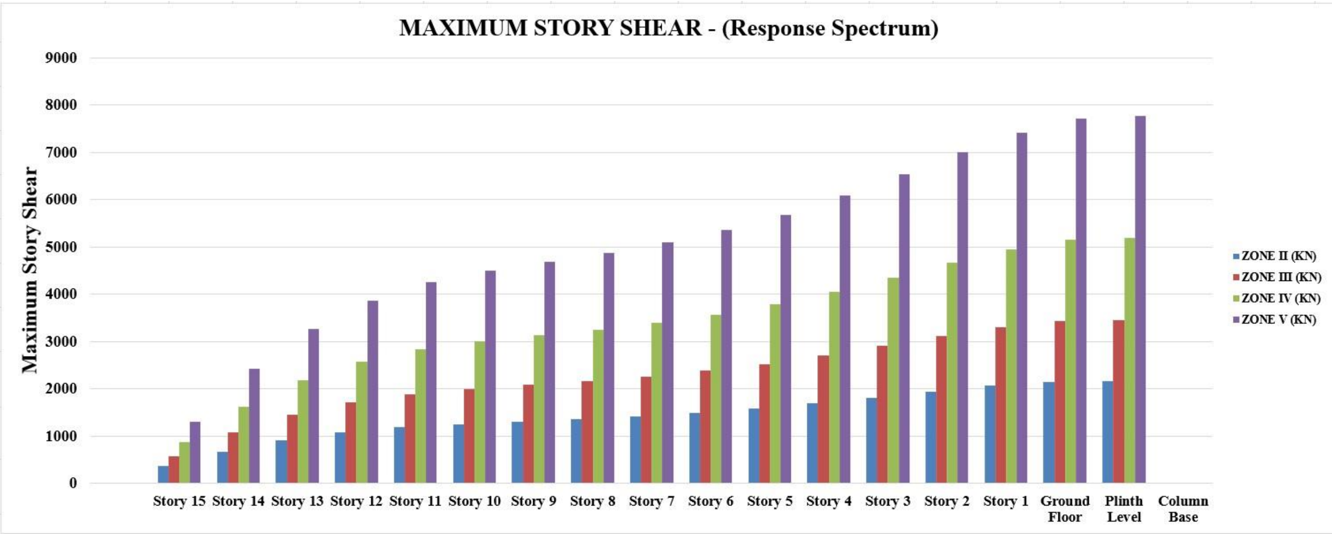


Fig 24. Comparison graph of Maximum Story Displacement

STORY	ZONE II (kN)	ZONE III (kN)	ZONE IV (kN)	ZONE V (kN)
Story 15	361.7152	578.7443	868.1164	1302.1746
Story 14	672.7839	1076.4542	1614.6813	2422.0219
Story 13	909.0784	1454.5254	2181.7881	3272.6821
Story 12	1074.2131	1718.741	2578.1114	3867.1672
Story 11	1181.5884	1890.5414	2835.8121	4253.7182
Story 10	1251.0929	2001.7487	3002.6231	4503.9346
Story 9	1303.4234	2085.4775	3128.2163	4692.3244
Story 8	1354.6918	2167.5069	3251.2603	4876.8905
Story 7	1414.5313	2263.2501	3394.8752	5092.3128
Story 6	1488.2359	2381.1774	3571.7662	5357.6492
Story 5	1579.4738	2527.1581	3790.7372	5686.1057
Story 4	1689.8289	2703.7262	4055.5893	6083.384
Story 3	1815.4811	2904.7697	4357.1545	6535.7318
Story 2	1944.9534	3111.9254	4667.8881	7001.8321
Story 1	2061.032	3297.6512	4946.4768	7419.7152
Ground Floor	2145.5824	3432.9318	5149.3977	7724.0965
Plinth Level	2160.2249	3456.3598	5184.5398	7776.8096
Column Base	0	0	0	0

Table 9. Maximum Story Displacement of Structure

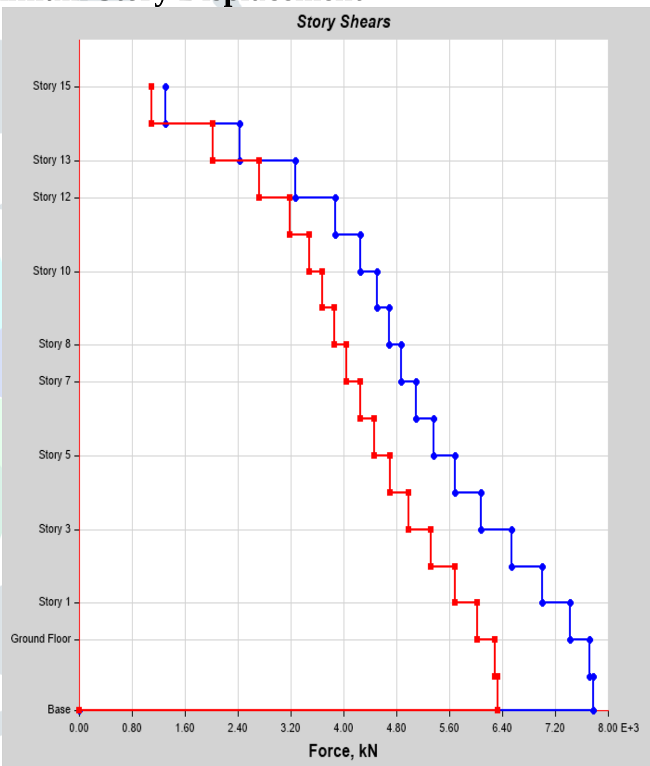


Fig 25. Maximum Story Displacement of Model I

From the above results it can be noted that URM Infill wall structures have the greater impact in the seismic resistance when compared to RC conventional structure.

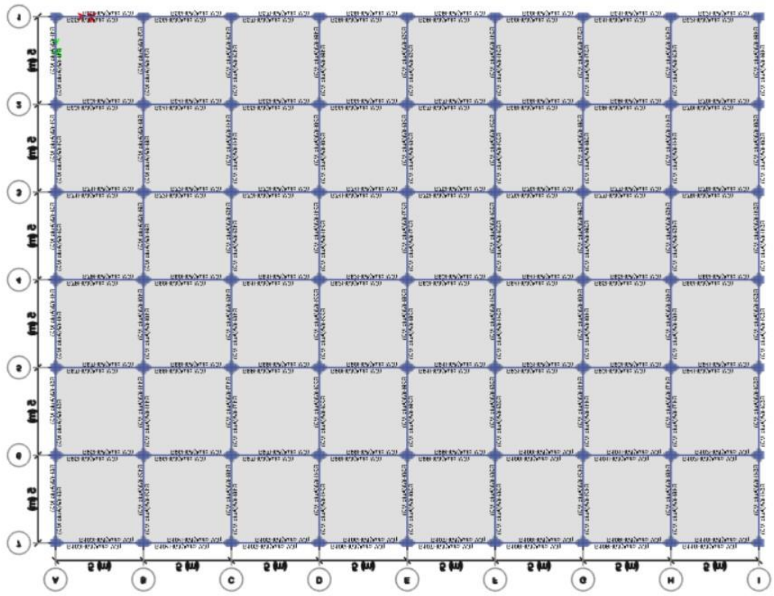


Fig 26. **Hinge Properties**

Now performing the Non-linear static Pushover analysis in the displacement control manner we got the results in terms of target displacement and performance point and base shear.

These define as follows:

- **a) Target displacement:** Target displacement is the maximum drift that a structure may experience under seismic stresses without completely collapsing.
- **b) Performance point:** For a certain damping ratio, the Performance Point—which denotes the condition of the structure's maximum inelastic capacity—can be discovered by finding the intersection of the Capacity Spectrum and Demand Spectrum.
- **c) Base shear:** Base shear is a measure of the greatest predicted lateral force that seismic activity will exert at the base of the structure.

5.2. RESULTS FROM PUSHOVER ANALYSIS - ZONE-V

5.2.1. MODEL I: (CONVENTIONAL RC STRUCTURE)

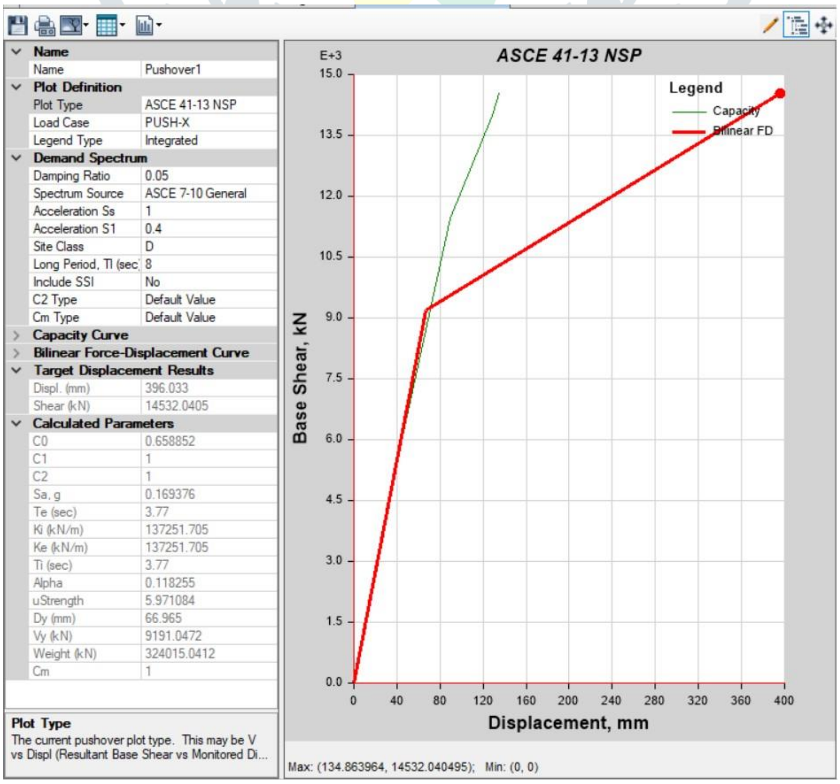


Fig 27. Target Displacement Point Results from ASCE 41-13 NSP

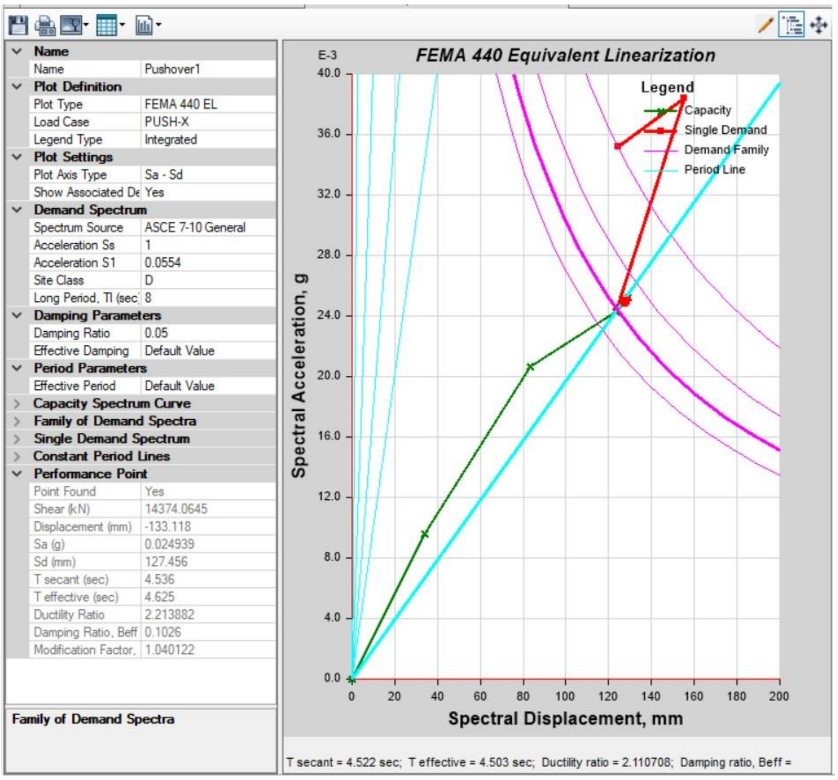


Fig 28. Performance Point Results from FEMA 440 EL

	Displacement (mm)	Shear (KN)
Target displacement Point	396.003	14532.0405
Performance Point	133.118	14374.0645

Table 10. Target displacement and Performance point

5.2.2. MODEL II: (URM INFILL WALL STRUCTURE)

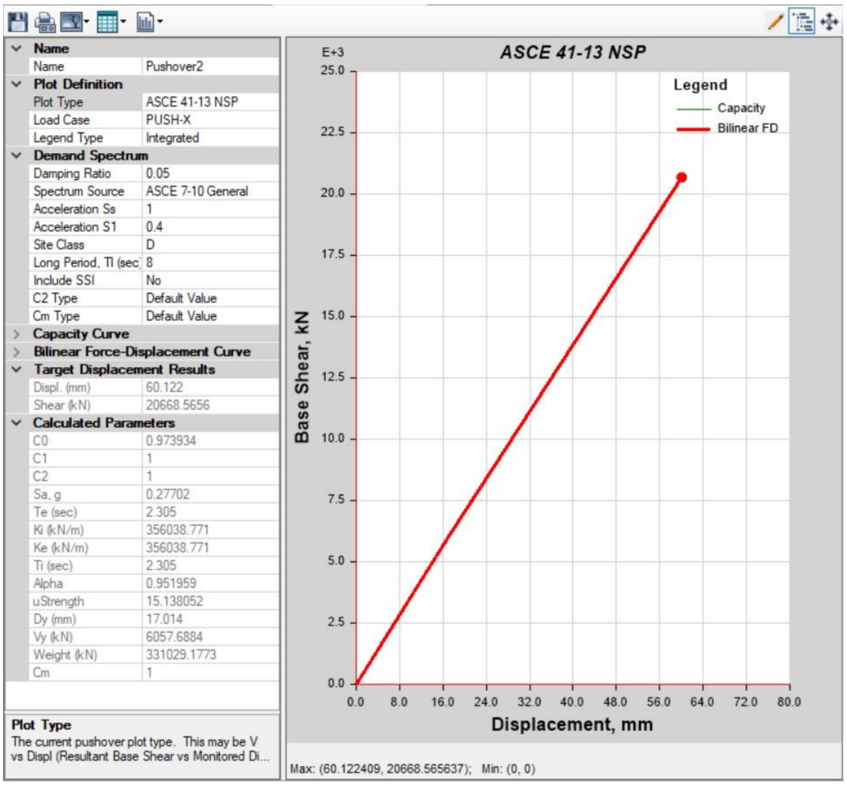


Fig 29. Target Displacement Point Results from ASCE 41-13 NSP

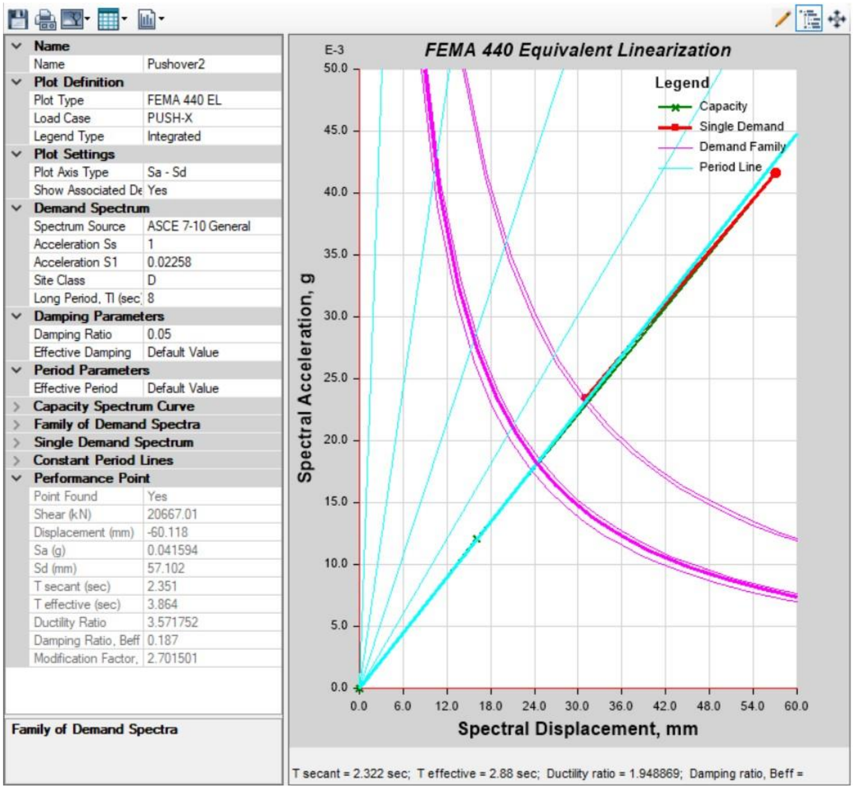


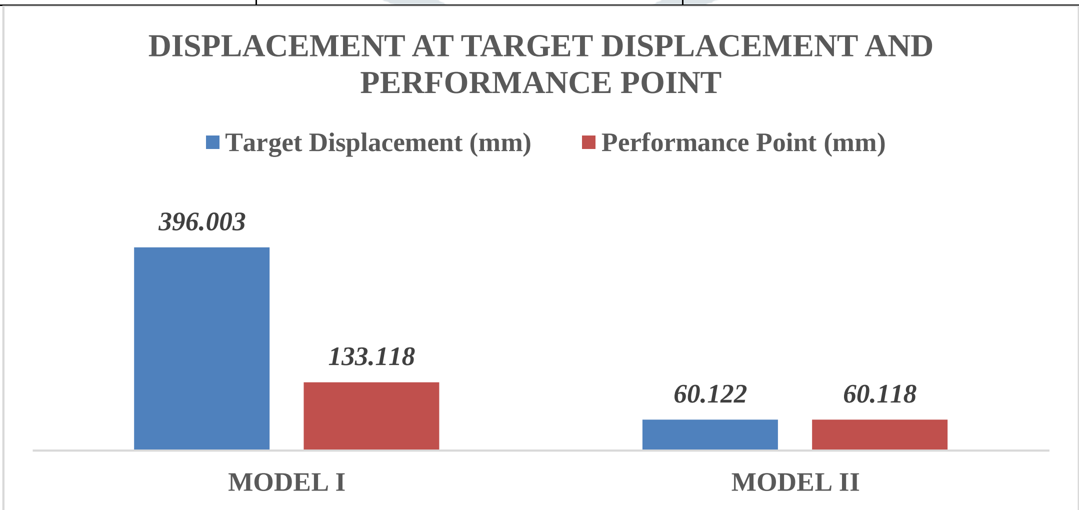
Fig 30. Performance Point Results from FEMA 440 EL

	Displacement (mm)	Shear (KN)
Target displacement Point	60.122	20668.5656
Performance Point	60.118	20667.01

Table 11. Target displacement and Performance point

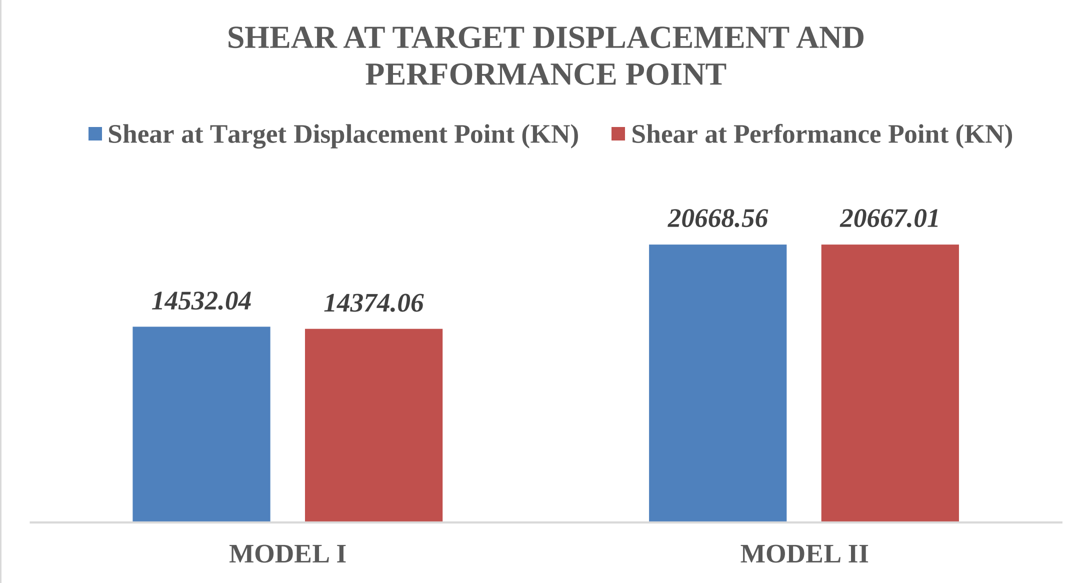
5.3. COMPARISION FROM PUSHOVER ANALYSIS

MODEL	Target Displacement (mm)	Performance Point (mm)
MODEL I	396.003	133.118
MODEL II	60.122	60.118



MODEL	Shear at Target Displacement Point (KN)	Shear at Performance Point (KN)
MODEL I	14532.0405	14374.0645

MODEL II	20668.5656	20667.01



Due to the seismic effects in the Zone V the maximum shear occurs at base of the structure, maximumstory displacement occurred at the top story which is story 15 and the maximum displacement of the structure is found out.

Both models' push over curves practically coincides in the Y direction. Pushover Curves from this study's findings demonstrate that the building's reaction towards the URM Infill wall structure and the RC Conventional structure differs significantly. The performance point and target displacement results also follow the same phenomenon as the maximum story displacement. Model II has the lower displacement results than the Model I.

From the above figures Model II have the compatibly more lateral displacement and performance points when performing nonlinearstatic pushover analysis.

VI. CONCLUSIONS

1. The building is more resistant to seismic acceleration thanks to the URM Infill wall construction. When a structure is modelled, the results of the modal analysis reveal certain peculiar modes. However, it is discovered that such forms get very little mass engagement. As a result, these modes won't materially alter the building's reaction.
2. It is effective to use the infill wall structure rather than the conventional structure because the performance point is very near and achieved at 60.122 mm for Zone V as well as the results from response spectrum analysis of the URM Infill are significantly better than the conventional structure. 2. Pushover Curves obtained from this study show that there is a considerable variance between the response of the URM Infill wall structure as well as RC Conventional structure.
3. When compared to a conventional structure in Zone V, the use of URM walls in the RC construction significantly reduced the maximum story displacement, story drift, and base shear. As a result, the conventional structure attracted fewer seismic forces.
4. The use of URM Infills modifies the structures' seismic behaviour. The models that used the URM Infill system responded well to all of the parameters, acting as a bracing framework.
5. When compared to Model I, Model II's base shear, tale displacement, and story drifts have all decreased.

This study thus concludes that the building is only secure when it has URM Infill walls and suggests that more research is required with various problems.

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