Impact of Intermittent Diaphragm and Re-entrant corners on Seismic Response of Multistoried RC framed Buildings.

Kazi Muhammed Mustaqeem,
PG Student,
Dept of Civil Engineering,
KBN college of Engineering
Gulbarga,Karnataka.

Md. Mansoor Ahmed,
Assistant Professor,
Department of civil Engineering,
KBN college of Engineering,
Gulbarga, Karnataka.

Abstract **-In multi-storied framed building, harms from seismic tremor by and large start at areas of structural weakness present in the lateral load resisting frames. Diaphragms with unexpected discontinuities or varieties in stiffness, which incorporates those having removed or open regions more prominent than 50 percent of the gross encased diaphragm area, or changes in viable diaphragm stiffness of more than 50 percent starting with one story then onto the next. In structural designing, a diaphragm is a basic framework used to exchange horizontal loads to shear walls or frames essentially through in-plane shear stress. Lateral loads are normally wind and seismic tremor loads.**

In this paper attempt has been made to study two sorts of arrangement namely diaphragm discontinuity and re-entrant corners in the structure. These irregularities are made according to provision 7.1 of IS 1893:2002(part1) code. Different irregular models were considered having diaphragm irregularity and re-entrant corners which were analyzed utilizing ETABS to decide the seismic reaction of the building. The models were investigated utilizing static, dynamic and pushover analysis and parameters considered being displacement, maximum drift, base shear, and time period. From the present study the model which is most vulnerable to failure under exceptionally extreme seismic zone is discovered.

Keywords - Diaphragm discontinuity, equivalent static, Response spectrum, pushover analysis, displacement, drift, base shear and time period.

1. INTRODUCTION

For a structure to perform well during earthquake, the structure ought to have four fundamental traits, in particular basic and general design, sufficient lateral strength, stiffness and ductility. Structures with straightforward normal geometry and consistently distributed mass and stiffness in plan and in addition in rise are considered to endure much lesser harm than structures with irregular designs. However, these days, with the progression in fast development of urbanization and for aesthetic reason structures with irregular arrangements are broadly built. These setups in structures prompt non-uniform appropriations in their masses, stiffness and strength accordingly they are inclined to damage amid tremors. Henceforth in present study an attempt has been made to think about the conduct of such structures situated in serious seismic zone.

The segment 7 of IS 1893(part1):2002 enrolls the abnormality in structures. These abnormalities are sorted as takes after

1. Vertical irregularities alluding to sudden change of strength, stiffness, geometry and mass results in unpredictable dissemination of strengths or conveyance over the stature of the building.
2. Plan abnormalities which allude to uneven arrangement shapes (L-, T-, U- and F-) or discontinuities in the horizontal resting components (diaphragm), for example, cut-outs, huge openings, re-entrant corners and other unexpected changes bringing about torsion, diaphragm disfigurements and stress concentration.

As said above plan abnormalities might be because of intermittent diaphragm or nearness of re-entrant corners in the structures. The diaphragm is a horizontal component that exchanges forces between vertical resistance components. The diaphragm intermittence may happen with unexpected varieties in stiffness, including those having removed or open ranges more than half of the gross encased diaphragm area, or change in viable diaphragm stiffness of more than half starting with one story then onto the next story. The re-entrant corners, where projections of the structure past the re-entrant corner are more than 15 percent of its plan measurement in the given direction is accepted in shapes like L, T, H, C, + shapes.

2. OBJECTIVE OF THE STUDY

To study the impact of intermittent diaphragm and re-entrant corners in tall structures under serious seismic zone considering parameters like displacement, drift, base shear and time period.

3. METHODOLOGY

A. Select the buildings with intermittent diaphragm and re-entrant corners.

B. Design the building as per prevailing Indian standards for dead load, live load and earth quake load in Etabs.

C. Analyze the building using, Equivalent static, Response spectrum, Pushover analysis methods.

D. Analyze the results and arrive at conclusions.

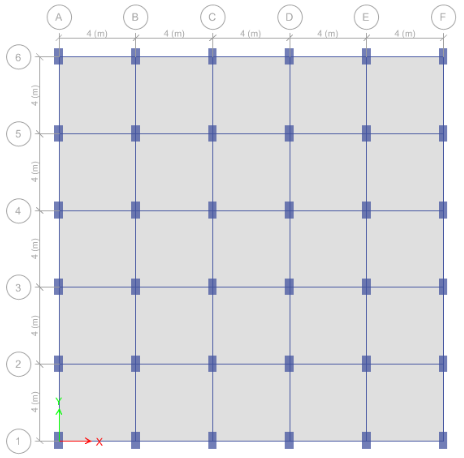
International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 07, July-2016

4. DETAILS OF THE BUILDING

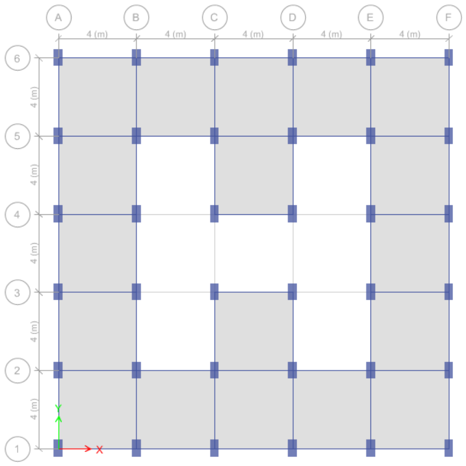
For study purpose, the layout of the plan having 5X5 bays of equal length of 4m is considered.. The building parameters are as follows,

A. Type of building: Ordinary moment resisting frame
B. Number of stories: 20
C. Seismic zone: V
D. Floor height: 3 m
E. Grade of Concrete: 30 Mpa
F. Grade of steel: Fe500
G. Beam dimension : 450mm x 850mm
H. Column dimension: 350mm x 650mm
I. Slab depth: 150mm
J. Dead load: 1.5 Kn/m^2
K. Live load : 2 Kn/m^2
L. Importance factor(IF): 1.5
M. Response reduction factor:3

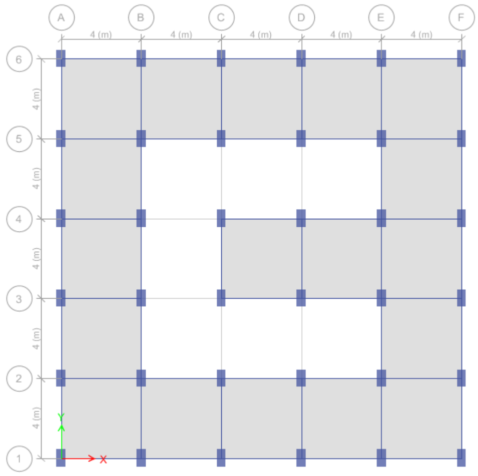
5. MODELS



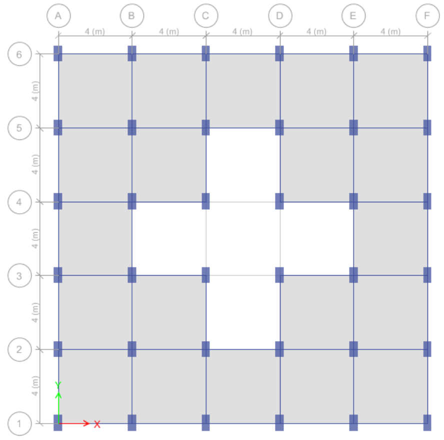
MODEL R-REGULAR



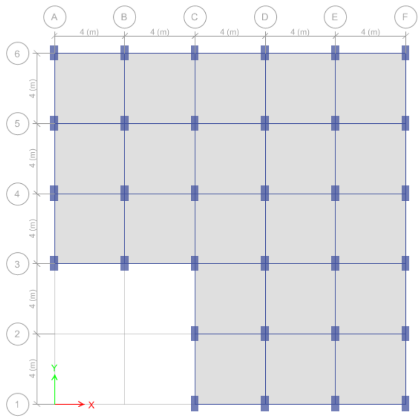
MODEL D1-H SHAPED



MODEL D2-C SHAPED

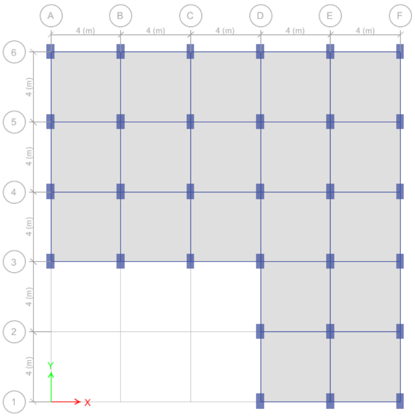


MODEL D3-PLUS (+) SHAPED

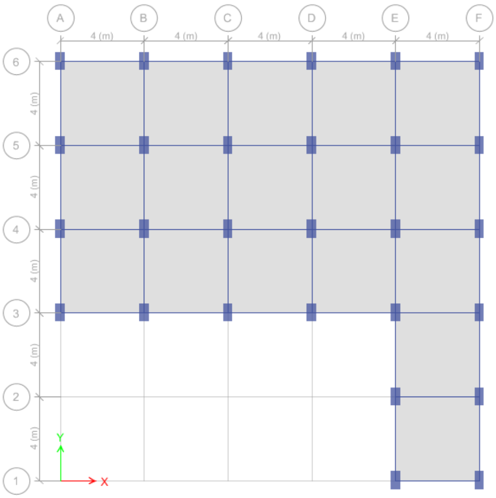


MODEL L1-40%

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 07, July-2016



MODEL L2-60%



MODEL L3-80%

Model Description

The arrangement setup comprises of,

MODEL R -Building in square shape.

MODEL D1 - Intermittent Diaphragm “H” in shape.

MODEL D2 - Intermittent Diaphragm “C” in shape.

MODEL D3 - Intermittent Diaphragm “+” in shape.

MODEL L1 - Re-entrant corners 40% in X course and 40% in Y heading.

MODEL L2 - Re-entrant corners 60% in X course and 40% in Y heading.

MODEL L3 – Re-entrant corners 80% in X course and 40% in Y heading.

6. RESULTS

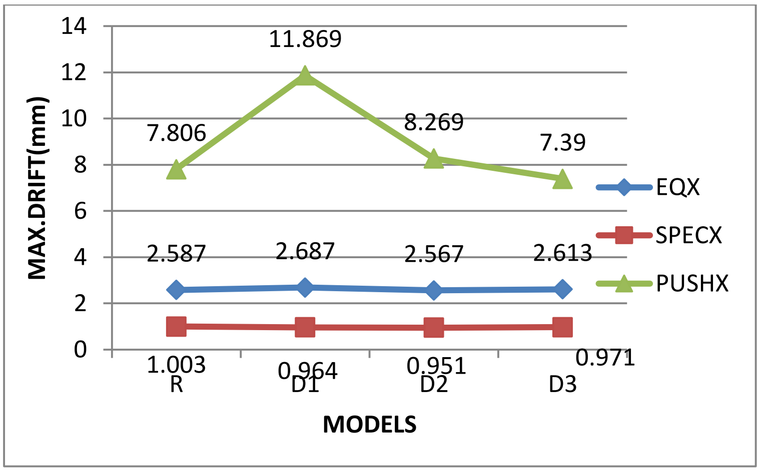


FIG 1: Plot of Maximum Drift VS Models for static, dynamic and pushover analysis in X direction.

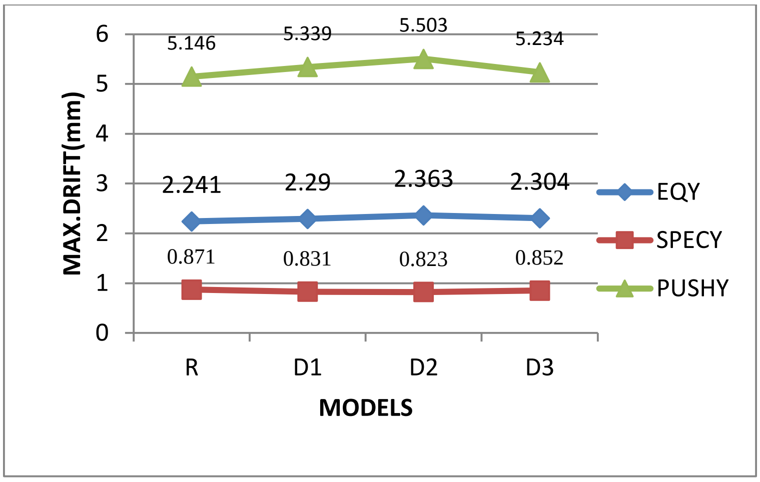


FIG 2: Plot of Maximum Drift VS Models for static, dynamic and pushover analysis in Y direction.

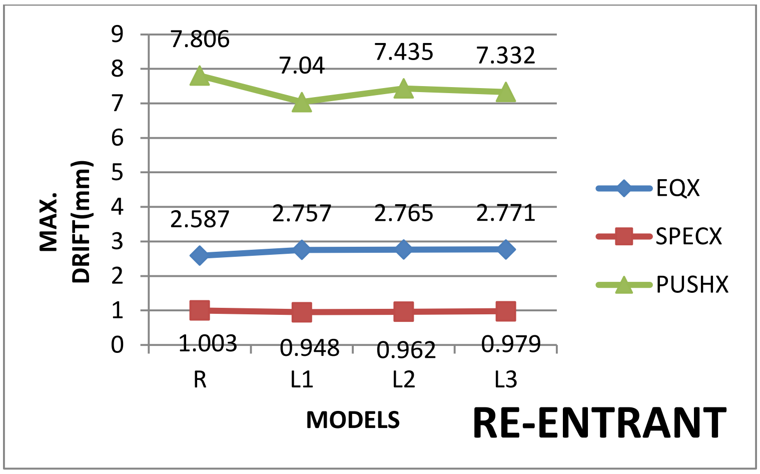


FIG 3: Plot of Maximum Drift vs Models for static, dynamic and pushover analysis in X direction

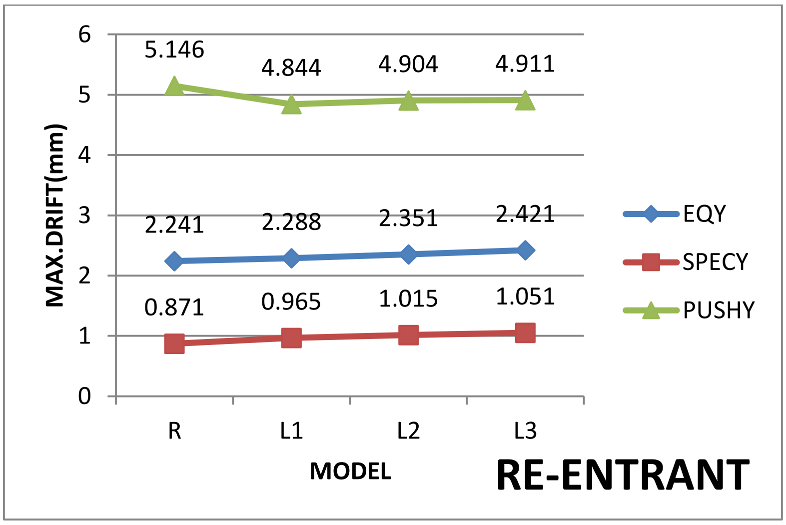
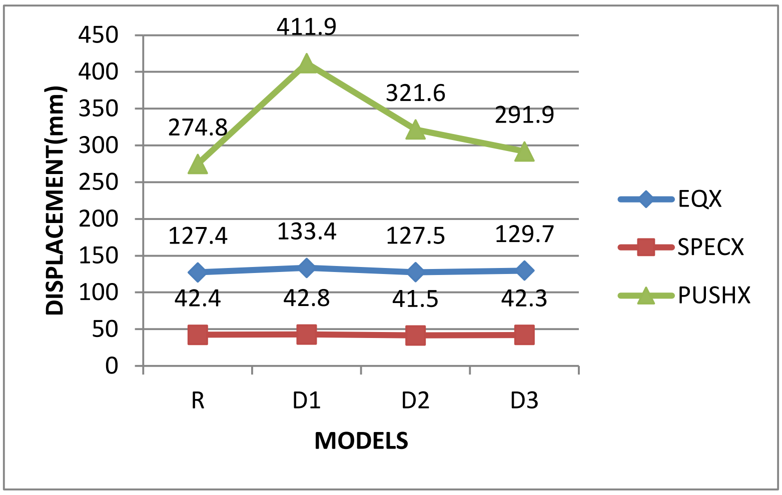


FIG 4: Plot of Maximum Drift vs. Models for static, dynamic and pushover analysis in Y direction



Note: Displacement increases with the increase in story, maximum value of the displacement which occurs at top story (20th story) is taken into account.

FIG 5: Plot of displacement vs Models for static, dynamic and pushover analysis in X direction

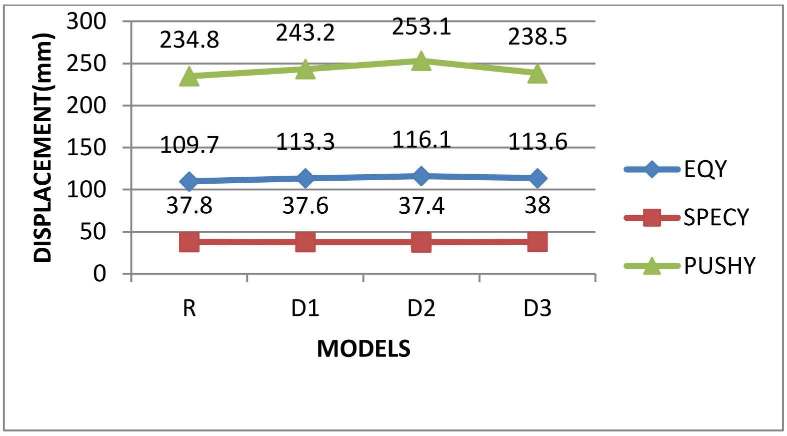


FIG 6: Plot of displacement vs. Models for static, dynamic and pushover analysis in Y direction.

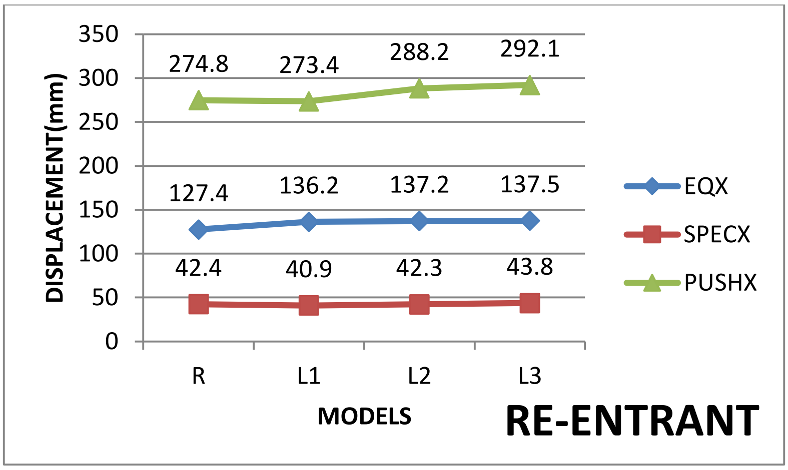


FIG 7: Plot of displacement vs Models for static, dynamic and pushover analysis in X direction

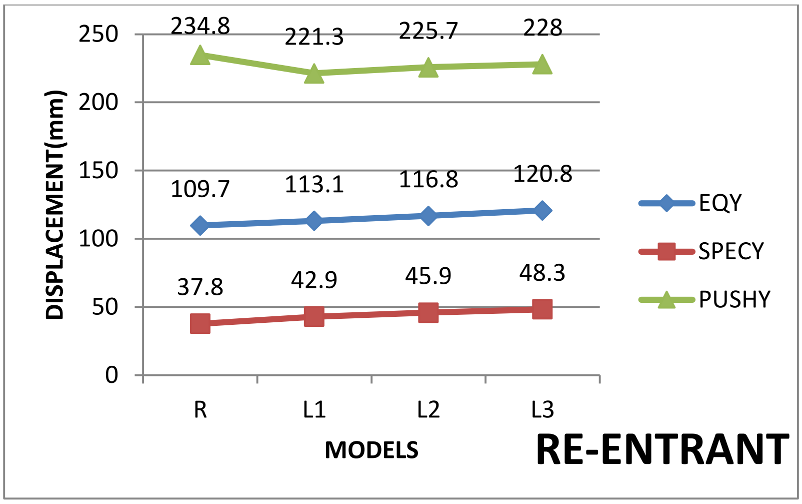
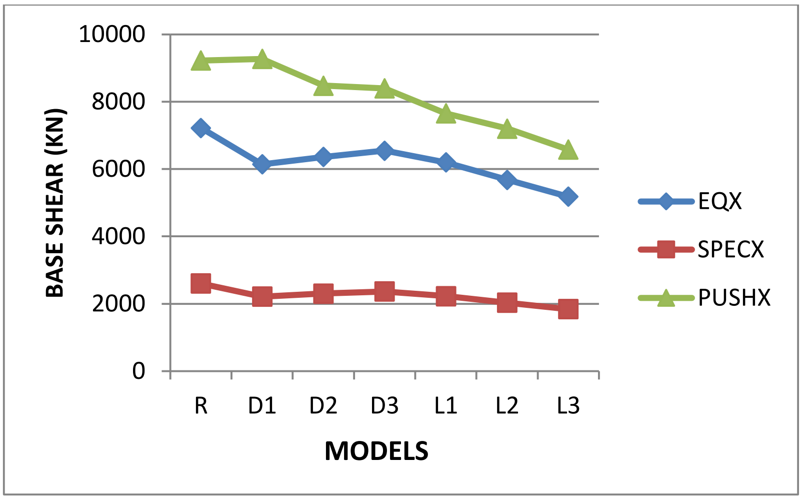
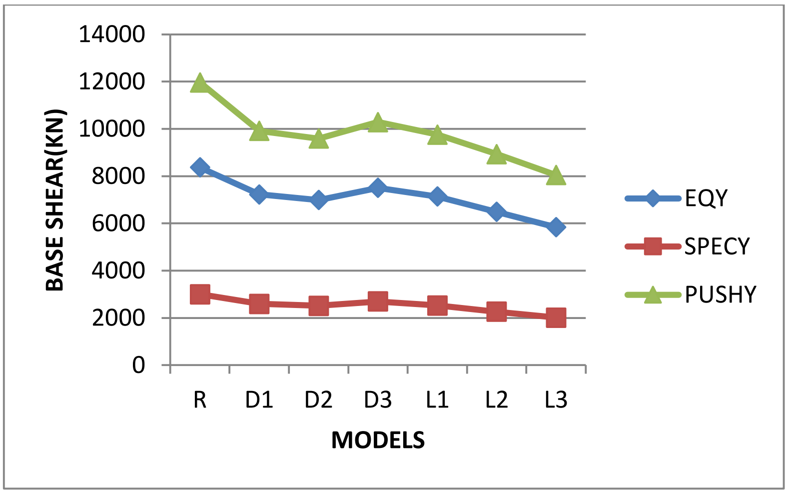


FIG 8: Plot of displacement vs Models for static, dynamic and pushover analysis in Y direction



MODEL	EQX	SPECX	PUSHX
R	7223.0472	2605.5461	9224.6186
D1	6140.0578	2215.1355	9272.4735
D2	6362.1965	2302.2275	8476.1454
D3	6546.9746	2365.017	8397.0863
L1	6199.44	2229.199	7653.1025
L2	5682.7961	2034.4815	7203.4801
L3	5183.3865	1843.4653	6581.4949

Fig 9: Plot of Base Shear vs Models for static, dynamic and pushover analysis in X direction



MODEL	EQY	SPECY	PUSHY
R	8371.7342	2997.5188	11968.0996
D1	7228.8852	2594.3637	9915.982
D2	6986.4978	2512.1483	9589.6261
D3	7504.5397	2694.0241	10288.5349
L1	7138.9033	2528.4777	9761.4323
L2	6486.8397	2264.2554	8933.4812
L3	5841.3677	2012.9565	8046.9711

Fig 10: Plot of Base Shear vs Models for static, dynamic and pushover analysis in Y direction.

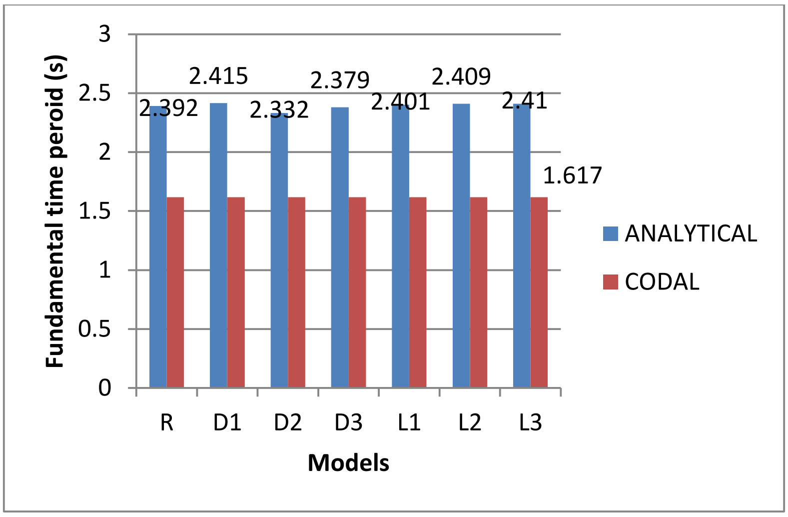


Fig 11.Plot of time period vs. Models for analytical and codal method.

7. CONCLUSIONS

A. When comparing the results of static and response spectrum method, the magnitude of displacement is more in static method as the response of the building is assumed to behave in a linear elastic manner.

B. Results of response spectrum method are more accurate. Response spectrum is based on known seismic activity. Static analysis is base shear analysis.

C. Pushover analysis gives higher value as compared to static and response spectrum method because in this method building is analyzed until the maximum capacity is reached.

D. Dynamic loads are applied as a function of time, this time varying load application induces time varying response (displacement, drift, forces and stresses), and these time varying characteristics make dynamic analysis more complicated and more realistic then static analysis.

E. From Fig.1&2, it is observed that the drift values are maximum for model D1 than the rest of the models hence is more susceptible for seismic forces.

F. From Fig.3&4, model L3 has maximum drifts as compared to the other models because of more re-entrant corners more (80%in X direction & 40% in y direction).

G. From Fig.5 & 6, it is observed that the displacement values remained almost same in static and response spectrum analysis for all models, whereas in pushover analysis model D1 gave higher displacement value as compared to rest of the models. Therefore model D1 is most vulnerable.

H. From Fig. 7&8, when comparing the re-entrant modes with regular model, it is seen that mode L3 is most vulnerable as re –entrant corners are more (80%in X direction & 40% in y direction.

I. From Fig. 9 & 10 the magnitude of base shear is maximum for regular mode R and minimum for re-entrant model L3, more the base shear of the building more will the member attract seismic forces. The influence of diaphragm opening played a major role in reducing the base shear hence attracting less seismic forces.

J. From Fig 11, results of fundamental natural period have proved that code IS 1893 does not consider the irregularity of buildings. The analytical method gives more accurate results as the time period is calculated on the basis of mass and stiffness of the building whereas the codal empirical formula depends only on the height of the building.

ACKNOWLEDGMENT

Above all else, acclaim and much gratitude go to God for the blessing that has been bestowed upon me in every one of my endeavors.

I am profoundly obligated to Md Mansoor Ahmed sir, assistant Professor of Structural Engineering department, my counsel and guide, for the inspiration, direction, tutelage and persistence all through the project work. I might want thank my Parents without their affection, persistence and bolster, I could not have finished this work.

At last, I wish to thank numerous friends for the encouragement and support.

REFERENCES

[1] Indian Standard code IS 18932-2002

[2] Turgut O. (2011) : " A study of the effect of slab gaps in buildings on seismic response according to three different codes" (Scientific research and essays vol 6)

[3] Moehle, J. P. (1984), "Seismic Response of Vertically Irregular Structures", JOSE (ASCE), Vol. 110. No. 9, 2002-2014.

[4] J. H. Cassis and E-Cornejo, "Influence of Vertical Irregularities in the Response of Earthquake Resistant Structures".

[5] FEMA 356 "Pre-standard and Commentary for the Seismic Rehabilitation of Buildings" Nov-2000.

[6] FEMA 440 "Improvement of Nonlinear Static Seismic Analysis Procedures" June-2005.

[7] IS 456 : 2000 "Plain and Reinforced Concrete Code of Practice (Fourth Revision)"

[8] Amin A. and Prof. P.S. Rao (2013) : "Influence of torsional irregularities of RC buildings in High Seismic Zone" (Australian journal of basic and applied sciences)

[9] Ravikumar C.M and Sujith B V l (2012) : "Effect of irregular configurations on seismic vulnerability of RC building" (Architecture Reasearch)