PUSHOVER ANALYSIS-TO STUDY SEISMIC PERFORMANCES OF VERTICAL IRREGULAR STRUCTURE

D.N.Shinde[1], Patil Sadhana M[2]

[1]*Associate Professor, Department of Civil Engineering, P.V.P.I.T. Budhgaon, Maharashtra, India*
[2]*Student, Department of Civil Engineering, P.V.P.I.T. Budhgaon, Maharashtra,*

Abstract

Now a day, a lot of attention is given to the make structure as earthquake resistant. Due to the earthquake huge amount of damage will takes place. To prevent this damage it is necessary to design earthquake resistant structures. So that the pushover analysis is one of the method to work out the seismic behavior of the structure. Pushover analysis is nonlinear static analysis to evaluate seismic performance of the building under the lateral loads. As a point of view of architectural consequence it is not possible to plan with regular shape. The present study represents the seismic response of the vertical irregular building frame as compared to the regular building frame. There are various types of vertical irregularities. The building frame considered for this study that are irregular in elevation. The present work is concerned with the static nonlinear analysis of G+7 RCC building frame with and without vertical irregularity by using design and analysis software ERABSv9.5.0 and both building frame design designed as per the Indian Standard 456:2000 and 1893:2002.The aim of present work is to check the seismic effect of vertical irregularity on building frame in terms of parameter lateral displacement, story drift and story shear, spectral acceleration and spectral displacement.

Keywords: *Pushover Analysis, Vertical Irregularity, Story Drift, Story Shear, Lateral Displacement, Spectral Acceleration, Spectral Displacement.*

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1. INTRODUCTION

Earthquake occurred in multi-storied building shows that if the structures are not well designed and constructed with an adequate strength it leads to the complete collapse of the structures. To ensure safety against seismic forces of multi-storied building, there is need to study of seismic analysis to design earthquake resistance structures.

The regular building have the building configuration almost same about the axis and there is lack of symmetry and discontinuity in geometry in case of irregular building. there are various types of vertical irregularities-i) stiffness irregularity ii)mass irregularity iii)vertical geometric irregularity iv)discontinuity in capacity-weak storey v) In plane discontinuity in vertical element resisting lateral force. The irregularity in elevation i.e. vertical geometric irregularity is considered for this work. Two building frame with and without vertical irregularity is considered. And the effect of vertical irregularity is studied in terms of parameter lateral displacement, story drift and story shear.A plot of the spectral displacement verses spectral acceleration i.e pushover curve is obtained by this analysis, which gives the performance point for the particular structure.

2. CASE STUDY DETAILS:

The RC building frame of G+ 7 floors is considered for obtaining performance point. Itconsists of 6 bays along both the directions. The typical storey height and ground storey height is same i.e. 3.0m.The bay width is 4.5m along x-direction and 3m along Y-direction. The frame is situated in zone III. The structural design data and seismic data is same for both the model.

M-I-Building frame without vertical irregularity

M-II-building frame with vertical irregularity.

2.1 Design Data:

Type of structure	: RC Moment Resisting Frame
Seismic zone	: III
Zone factor	: 0.16
Number of storey	: G+7
Floor height	: 3m
Base Floor height	: 3m
Infill Wall	: 230mm thick
Live load	: 4.0 kN/m^2

Floor Finish : 1.0 kN/m^2

Earthquake load : As per IS-1893 (Part 1)200 2

Type of soil : Type II, medium soil.

2.2 Description of Building Frame:

No. Bays along X axis : 6

No. Of bays along Y axis : 6

Spacing along X axis : 4.5m

Spacing along Y axis : 3m

Story height: 3m

No. Of floors: G + 7

Sizes of column : C1=520X480mm for ground floor

C2=480x420mm for 1st floor

C3=420x380mm for 2nd floor

C4=380x340mm for 3rd floor

C5=340x300mm for 4th floor

C6=300x250mm for 5th floor

C7=280x220mm for 6th floor

C8=240x200mmfor7thfloorsizes of column :

B1=420X380mm for 1st floor

B2=420X380mm for 2nd floor

B3=380X340mm for 3rd floor

B4=380X340mm for 4thfloor

B5=340X320mm for 5th floor

B6=340X320mm for 6th floor

B7=320x300mm for 7th floor

B8=300X260mm for 8th floor

3. MODELING AND ANALYSIS OF BUILDING FRAME WITHOUT VERTICAL IRREGULARITY (M-I)

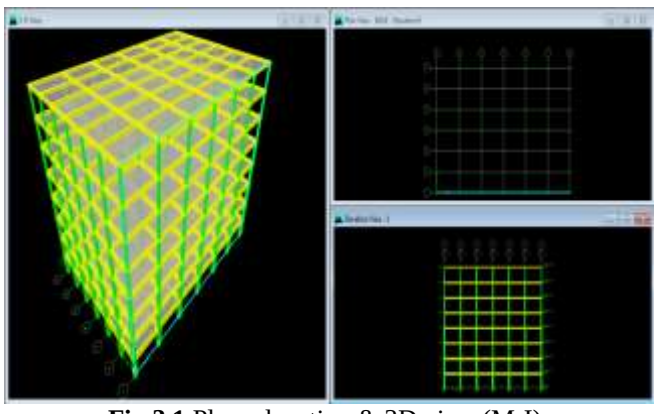

Fig.3.1.Plan, elevation & 3D view (M-I)

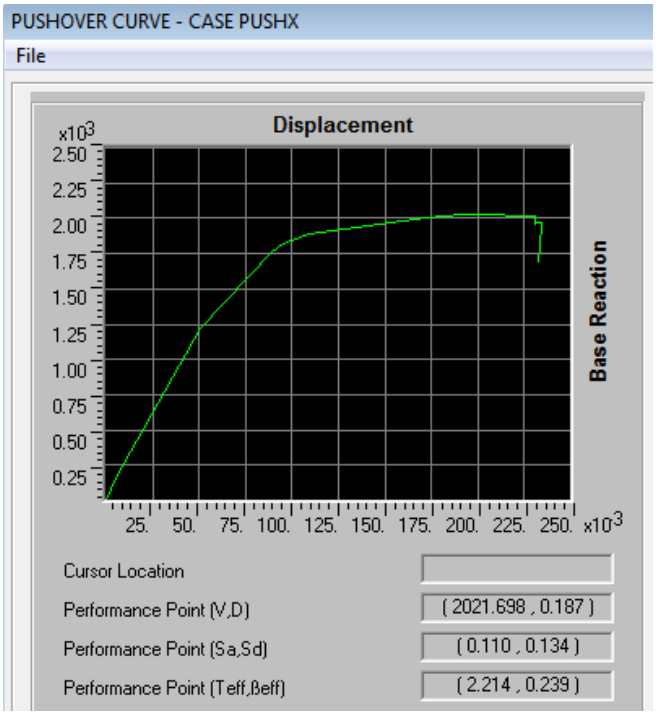

Fig.3.2.pushover curve (M-I)

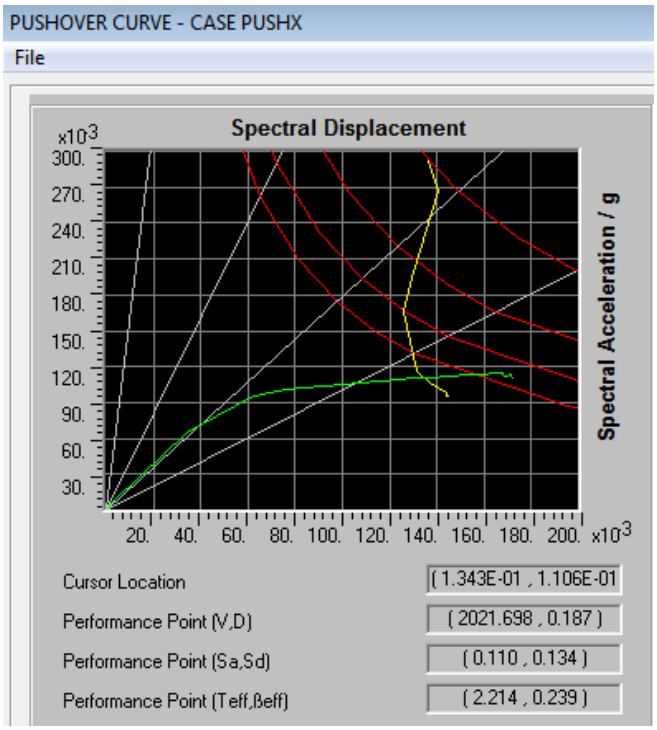

Fig.3.3 Performance point-Capacity and demand curve (M-I)

The demand curve and capacity curves are obtained to get the performance point of the structure. The performance point is obtained as per ATC40 capacity spectrum method. For building frame without vertical irregularity (M-I) base shear at the performance point is 2021.698kN.

4. MODELING AND ANALYSIS OF BUILDING FRAME WITH VERTICAL IRREGULARITY (M-II)

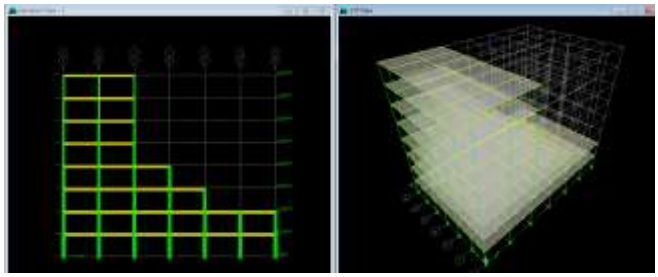

Fig.4.1. elevation & 3D view (M-II)

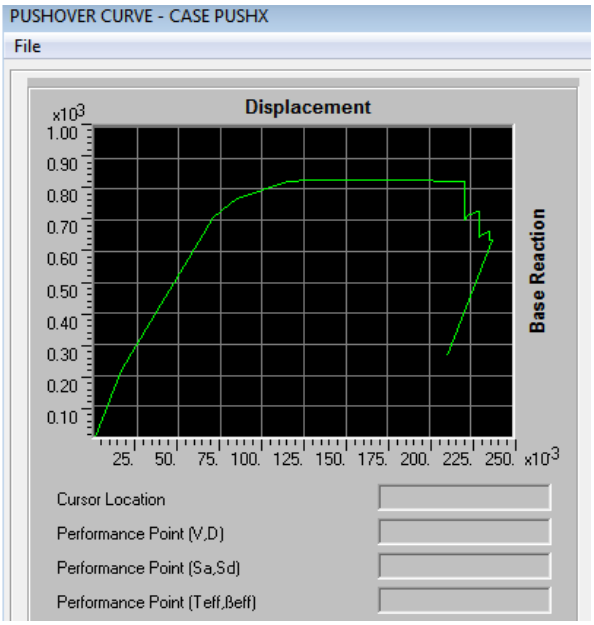

Fig.4.2.pushover curve (M-II)

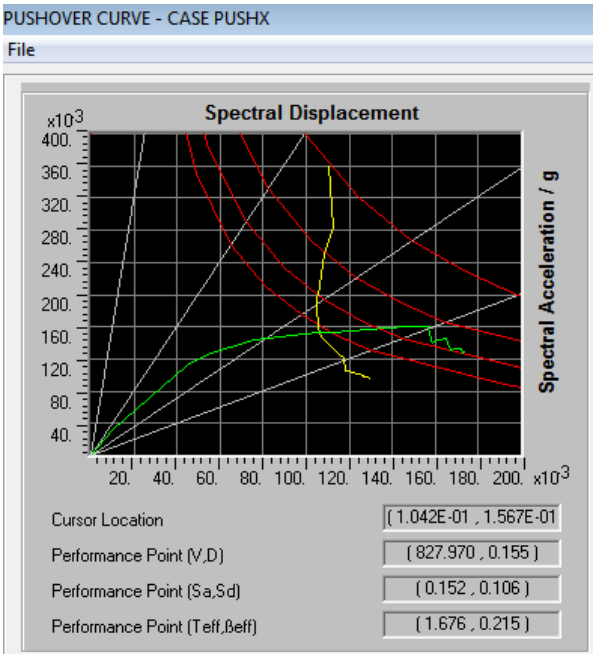

Fig.4.3 Performance point-Capacity and demand curve (M-II)

For the building frame with vertical irregularity (M-II) base shear at the performance point is 827.970kN.

5. PUSHOVER ANALYSIS

5.1. Lateral Displacement

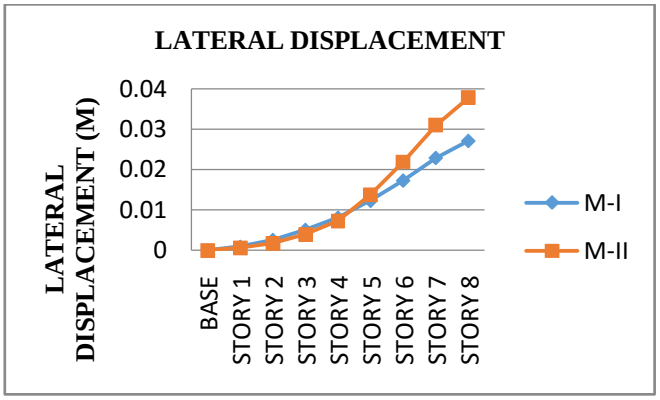

Fig.5.1.. Variation in lateral displacement

5.2. Story Drift

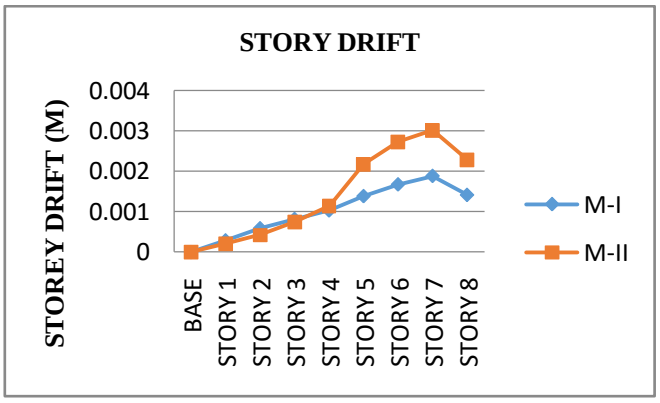

Fig.5.2.variation in story drift

5.3. Story Shear

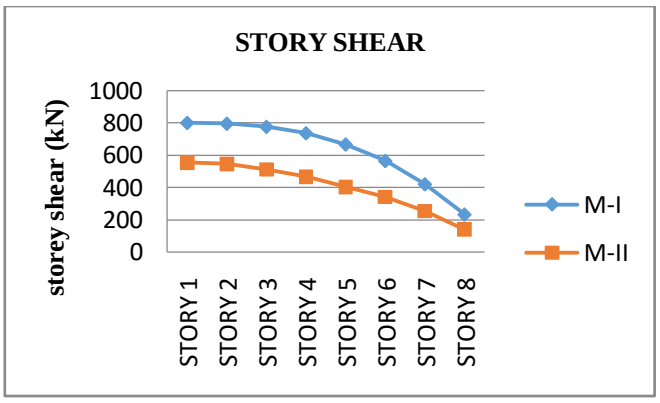

Fig.5.3.variation in story shear

5.4 Analysis Result

Table- comparison of building performance(X)

	M-I	M-II
Base shear at performance point (kN)	2021.698	827.97
Displacement at performance point (kN)	0.187	0.115
Spectral acceleration (m/s2)	0.11	0.152
Spectral Displacement (m)	0.134	0.106
Story displacement (m)	0.0271	0.0378
Story Drift (m)	0.001878	0.003011

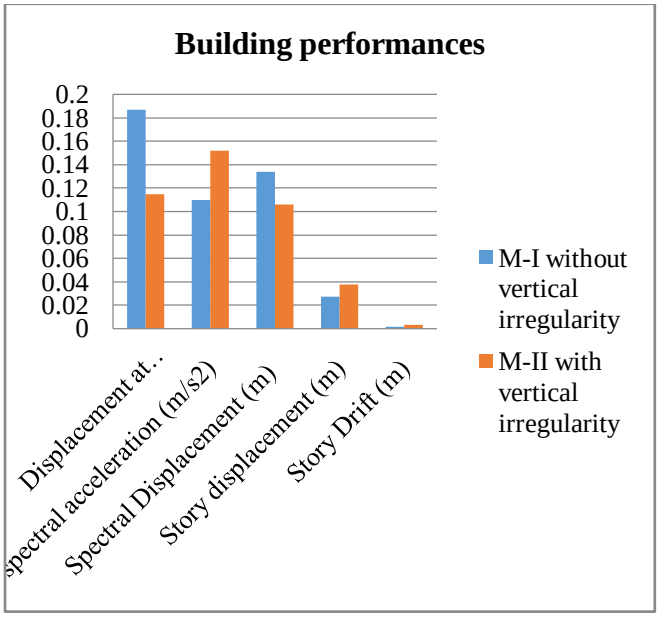

Fig.5.4. 1.building performances

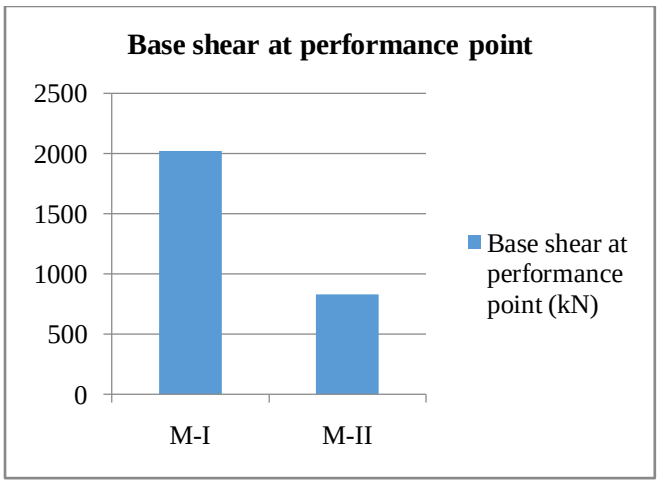

Fig.5.4.2.building performances-variation in base shear

From the above result it is observed that overall performance of irregular structure is critical as compared to the regular structure.

6. CONCLUSION:

G+7 building frame model (M-I) without vertical irregularity and (M-II) with verticalirregularuty is analyzed by using design and analysis software ETABSv9.5.0. The present study has lead to the following conclusions:

1) The lateral displacement and storey drift of vertical irregular structure is more as compared to the vertical regular structure.(Fig.5.4.1)
2) By the provision of vertical irregularity the spectral acceleration get increases and spectral displacement get reduces.(fig.5.4.1)
3) The building frame with vertical irregularity having less performance point value as compared to the building frame without vertical irregularity. It means the lateral load capacity of regular structure is more as compared to the irregular structure.

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