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Performance Based Analysis of R.C Building

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Abstract: *A large number of multi-storey reinforced concrete (R/C) framed building structures inIndia and almost all the countries are constructed as regular building, stiffness irregularity and Vertical irregularity. For its aesthetic view or for economic purpose. The effect of displacement and base force for structures is investigated on the seismic performance of the frame under strong ground motions using nonlinear static push-over analysis based on realistic and efficient computational models. From non-linear static pushover analysis compared Base force and Displacement of regular building structure, stiffness irregularity structure and Vertical irregularity structure. This paper aims to evaluate the zone –IV chosen reinforced concrete building to behavior of non-linear static analysis (Pushover Analysis). The pushover analysis shows the pushover curves and performance level of the building. This non-linear static pushover analysis gives superior understanding and more exact seismic performance of buildings of the damage or failure component.*
Keywords: *Multistory building, Curtailment of column, Open first storey, Pushover analysis, Comparison of graphs*

I. Introduction

In last few years various damages to structure occur due to the lack of seismic evaluation. Also most of the buildings in past few years are seismically deficient due to lack of awareness regarding behavior of structure at the time of earthquake. Among different frame system rigid joint is most constructed pattern in almost all the countries which is also known as beam-column joints.

Various regular and irregular structures show the different performance during earthquake. Most commonly it is seen that the building having curtailed section of column and the building having constant column section from bottom to top having different seismic performance during earthquake, its displacement and base forces varies. Sometime the structure consisting curtailed column section is more stable than the structure having constant column section and also its behavior depend on the type of structure and number of storey. Size and shape of column is depends on the load acting on it and its seismic behavior depend on the type of magnitude and earthquake.

In these paper three types of G+ 8 structures is taken for non-linear static pushover analysis that is regular structure, structures having stiffness irregularity and structure having vertical irregularity. All this structures having same grade of material, grade of steel, seismic zone etc.

The main purpose of this study to check the performance of different type of structure during earthquake. There displacement and base force may be varies according to type of structure.

II. Details of Non-Linear Static Pushover Analysis

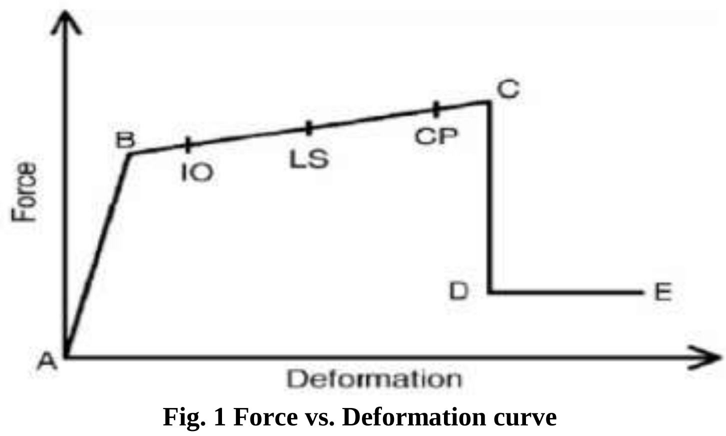


Fig. 1 Force vs. Deformation curve

The performance levels (IO, LS, and CP) of a structural element are represented in the load versus deformation curve as shown below,
1. A to B – Elastic state,
i) Point 'A' corresponds to the unloaded condition.
ii) Point 'B' corresponds to the onset of yielding.
2. B to IO- below immediate occupancy,
3. IO to LS – between immediate occupancy and life safety,
4. LS to CP- between life safety to collapse prevention,
5. CP to C – between collapse prevention and ultimate capacity,
i) Point 'C' corresponds to the ultimate strength
6. C to D- between C and residual strength,
i) Point 'D' corresponds to the residual strength
7. D to E- between D and collapse
i) Point 'E' corresponds to the collapse.

III. Details of Structural Model

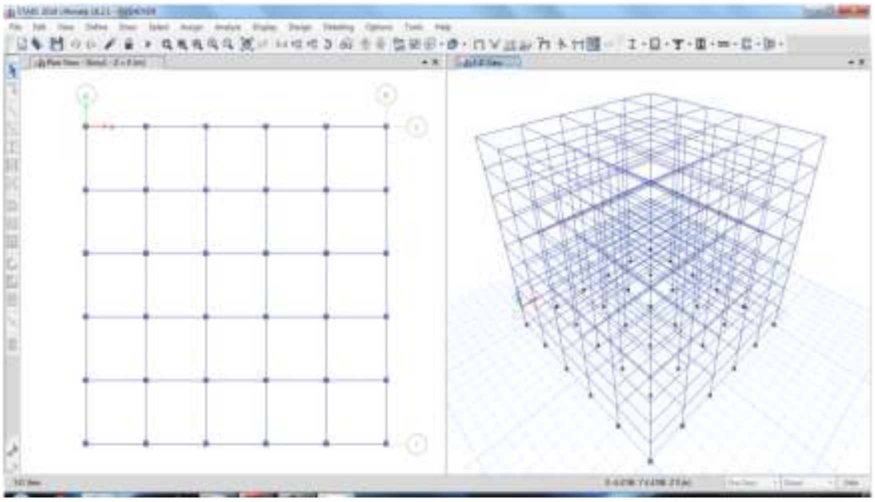
In this paper the three models were consider that is regular structure, structure having stiffness irregularity and structure having vertical irregularity. Details of the plan shown in Fig. 2, Fig. 3, Fig. 4, Fig. 5

3.1 Data taken for structure

- Type of structure Multistory (G+8 story) RCC building
- Height of the building 25.60 m
- Floor to floor height 3.2 m
- Depth of foundation 3.2 m
- Height of parapet wall 1.0 m
- Depth of slab 120 mm
- External walls 230 mm
- Internal walls 230 mm
- Brick masonry 19 kN/m^3
- Floor finish 2 kN/m^2
- Imposed load on floors 3 k N/m^2
- Importance factor 1.5
- Type of soilmedium
- Zone V
- Zone factor 0.36

3.2 Properties of Grade of Concrete and Steel

- Grade of concrete = M20
- Grade of steel = Fe415
- Density of concrete = 25kN/m3



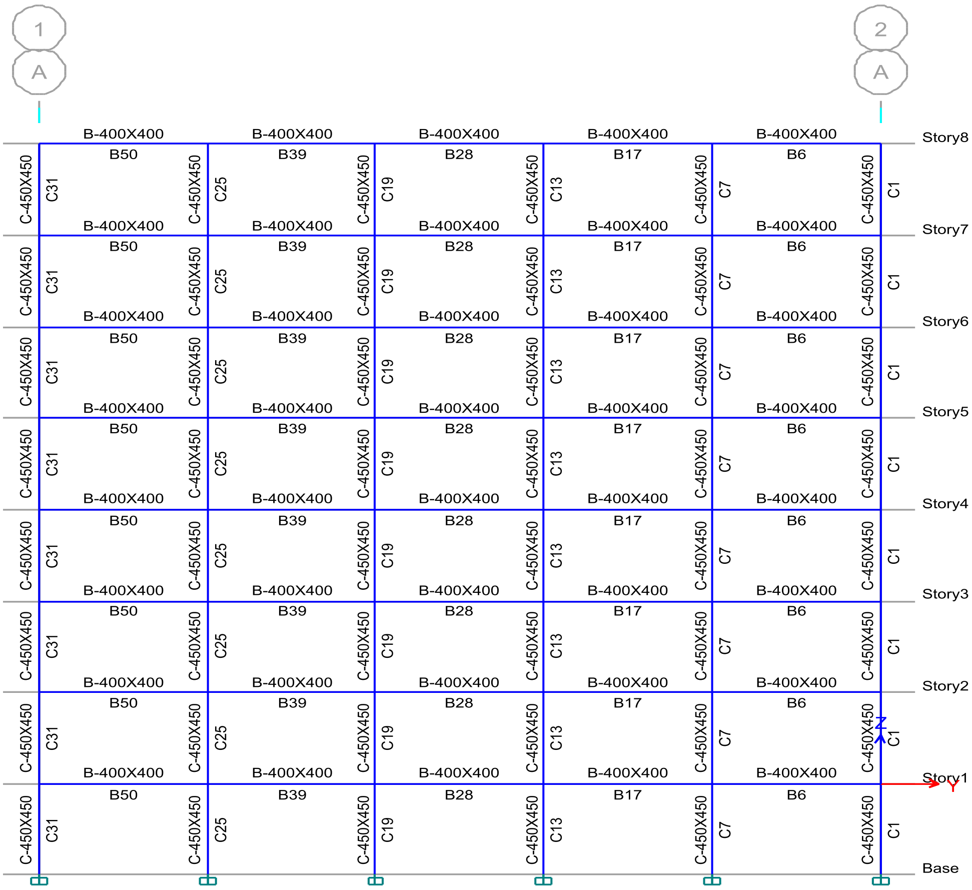
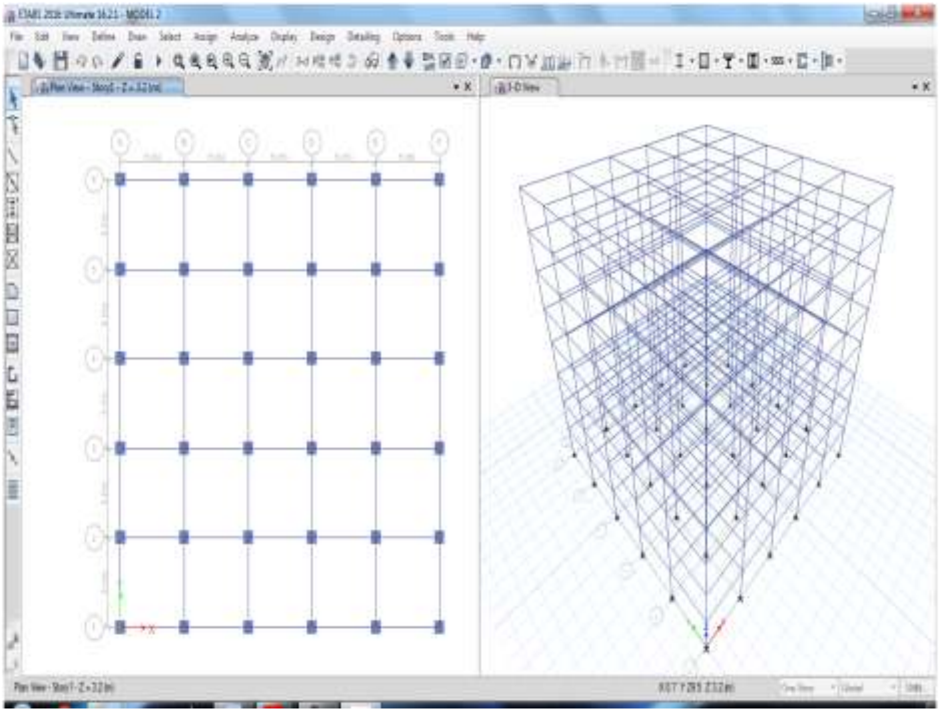


Fig. 2 Regular building having constant column size



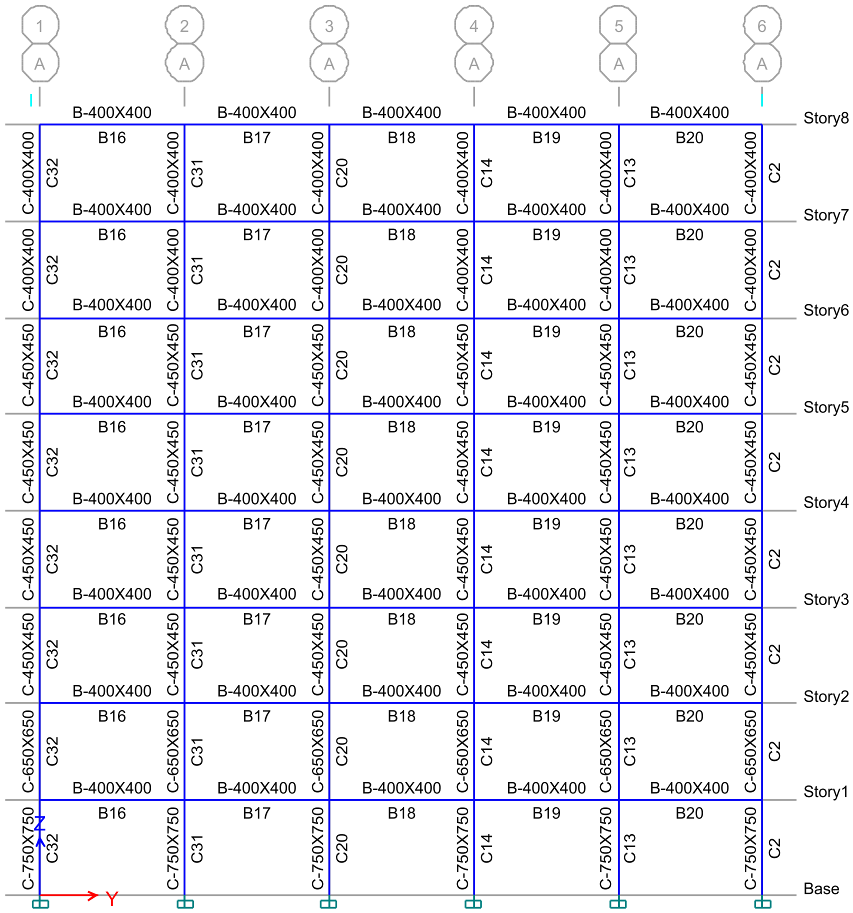
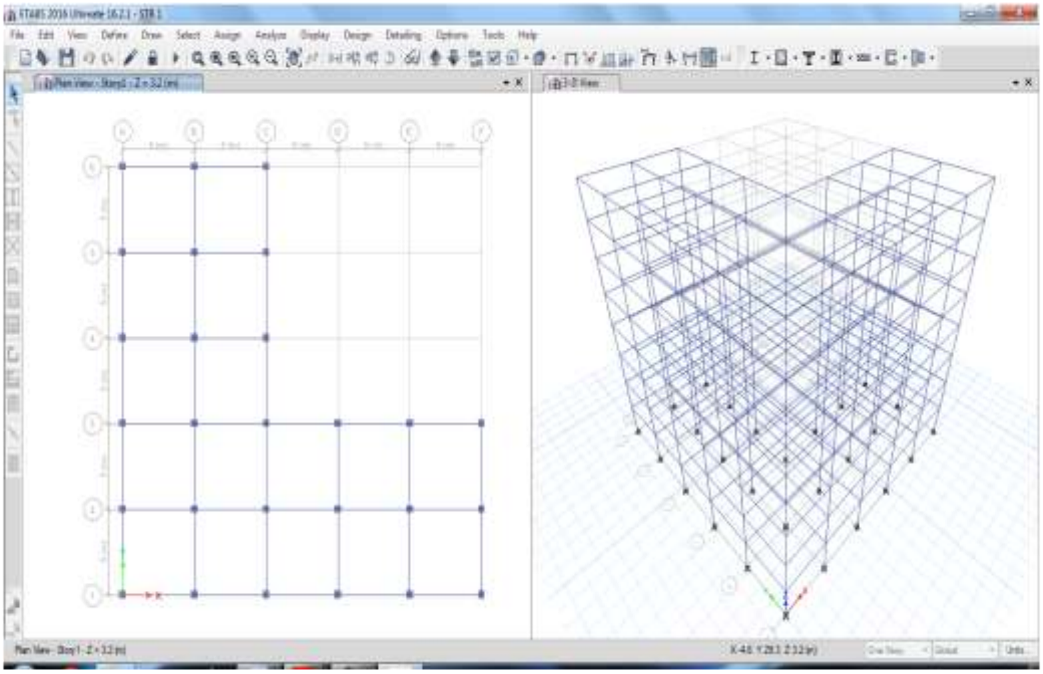


Fig. 3 Structure with stiffness irregularity



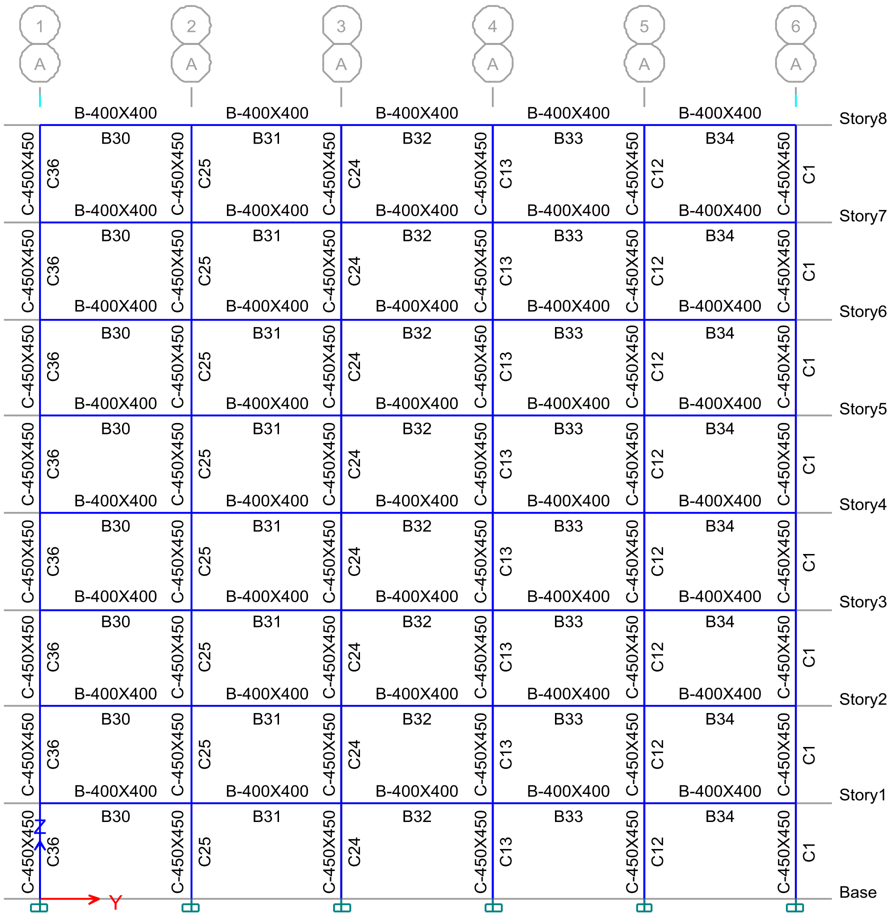
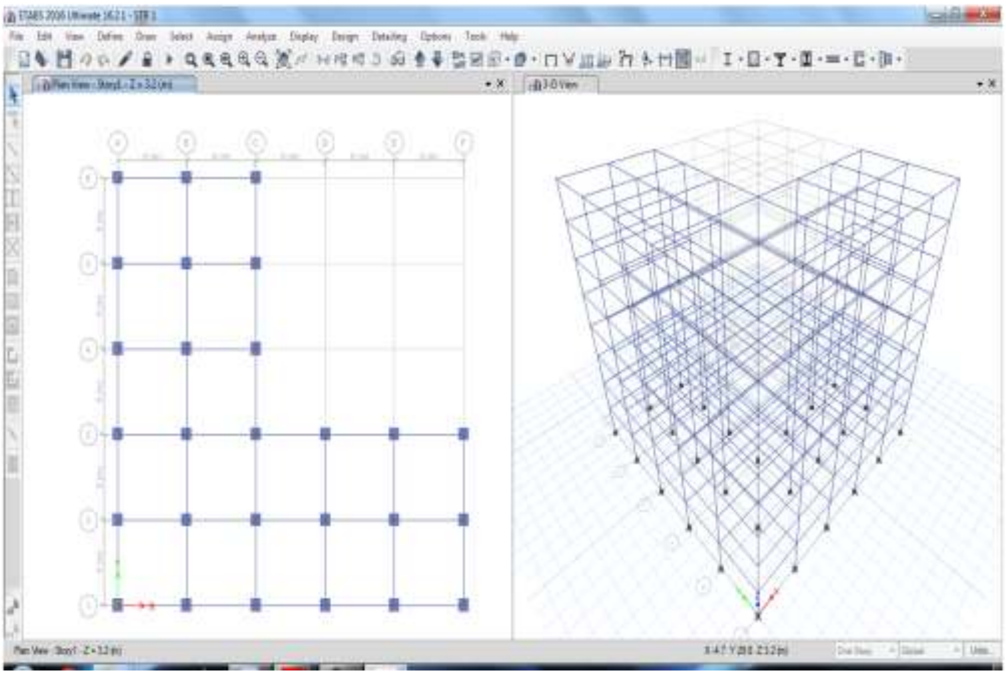


Fig. 4 Structure with vertical irregularity (constant column)



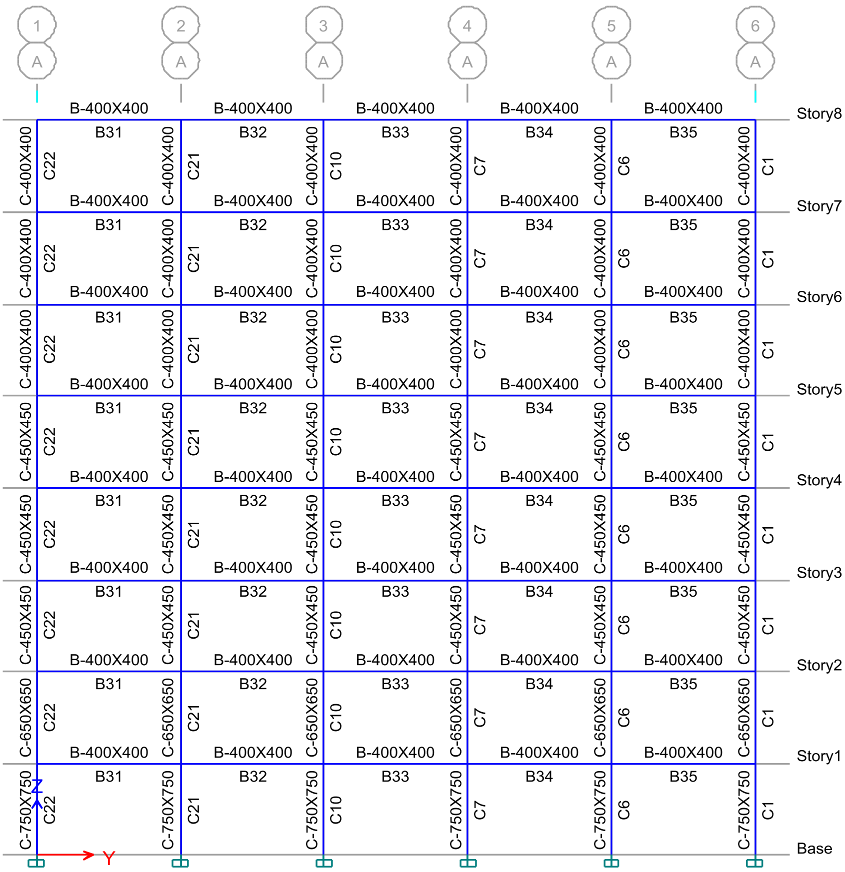


Fig. 5 Structure with vertical irregularity (curtailed column)

3.3 Loading calculation

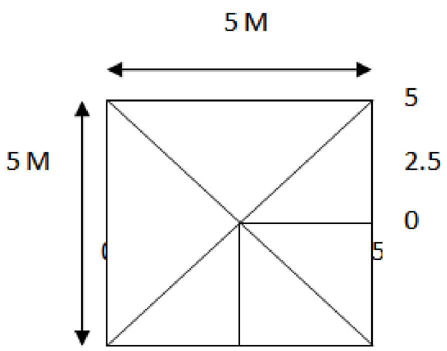
- Wall load- (3.2-0.4)x0.230x19 = 12.236kN/m
- Slab load- thickness of slab = 120mm

  Load = 0.12x25

  = 3kN/m^2

  Slab load = 3x2.5

  =7.5 kN/m @ 2.5m on each panel
- Live load = 3 kN/m



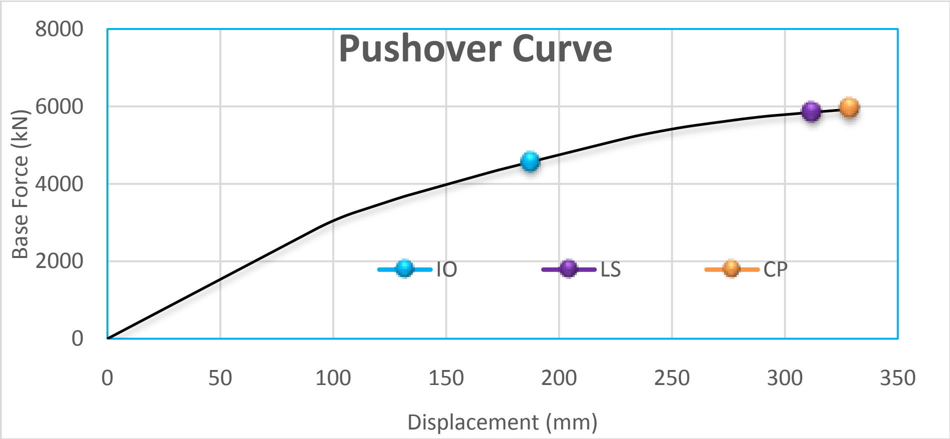
IV. Process of Pushover Analysis

1. Create the basic computer model (without the pushover data) in the common method using the graphical border of ETABS makes this quick and easy mission.
2. Define properties to all the members of structure and similarly define load pattern such as dead load, live load, wall load, slab load, EQX & EQY

3. Assign the loads such as dead load, wall load, slab load, live load EQX & EQY
4. The plan includes quite a few built-in default hinge properties that are base on average values from ATC-40 for concrete members and average ideals from FEMA-356 for steel members. These built in properties can be helpful for preliminary analyses, but user-defined properties are recommended for final analyses. This example uses default properties.
5. Locate the pushover hinges on the structure by selecting one or more frame member and assigning them one or more hinge property and hinge locations.
6. Run the basic static analysis and design the structure and also verify that all members are passed
7. Define the pushover load cases in ETABS more than one pushover load case can be run in the similar analysis. Also a pushover load case can start from the closing conditions of an additional pushover load case that was previously run in the similar analysis.
8. Select all the beams member and assign the hinges similarly select all the column member and assign the hinges
9. Run the pushover analysis it takes near about 1 to 1½ hours to complete the process of analysis
10. After completion of analysis process display the pushover curve it shows displacement and base force at different height

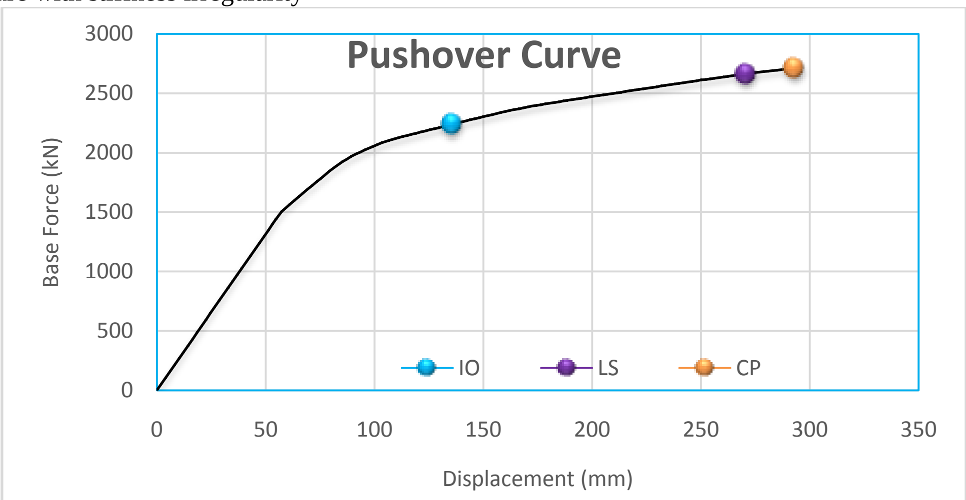
V. Results and Discussions

1. Regular building having constant column size



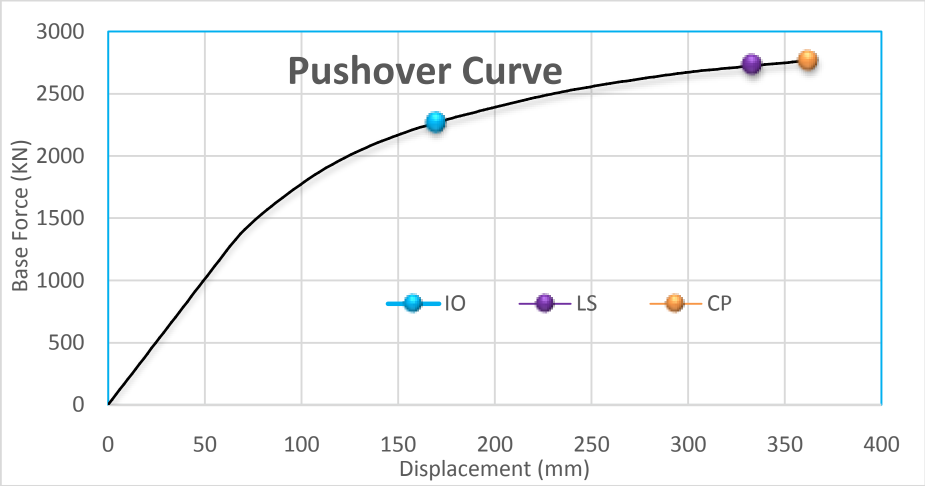
IO		LS		CP	
Displacement(mm)	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**
187.4247724	4568.296338	312.3527724	5852.201139	328.7367724	5930.28061

2. Structure with stiffness irregularity



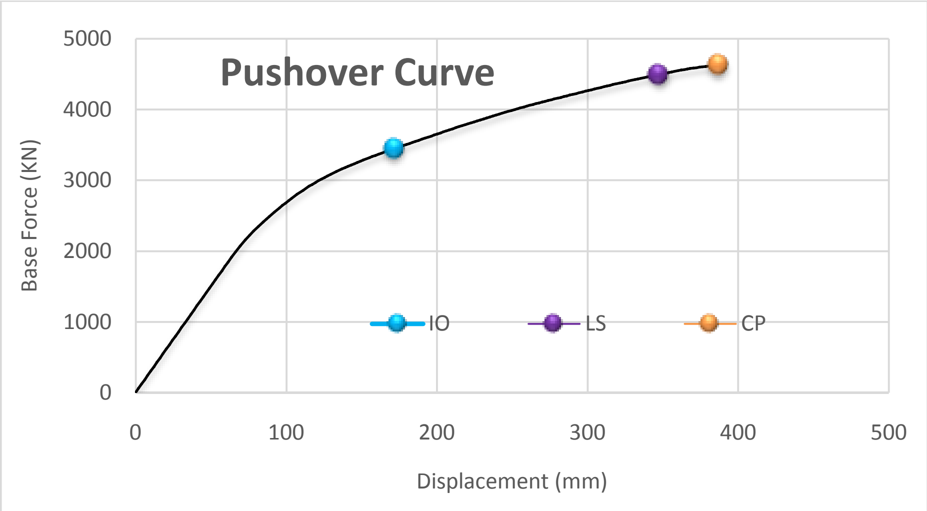
IO		LS		CP	
Displacement(mm)	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**
135.6569	2237.563	270.6993	2662.985	293.2273	2710.416

3. Structure with vertical irregularity (constant column)



IO		LS		CP	
Displacement(mm)	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**
169.698673	2268.21	333.5387	2725.365	362.7207	2767.241

4. Structure with vertical irregularity (curtailed column)



IO		LS		CP	
Displacement(mm)	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**	**Displacement(mm)**	**Base shear (kN)**
171.71844	3443.077	347.8464	4494.663	386.7584	4626.374

VI. Conclusion

From the above result it is conclude that the minimum value of IO, LS, CP Point is obtained in the Structure with stiffness irregularity curve. It is also conclude that the maximum value of IO, LS, CP Point is obtained in the Structure with vertical irregularity (curtailed column) curve. From the study of above structures it is conclude that maximum strength is obtained to the structure with stiffness irregularity, while minimum strength is obtained to the Structure with vertical irregularity (curtailed column)

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