Research Analysis and Seismic performance of RCC irregular Building with shape and stiffness

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***Abstract*— when a building is subjected to heavy loads, which includes both earthquake and wind loads, a major collapse of the building will occur. Many modern buildings contribute to the value of the buildings and it is very difficult to plan with a standard design. This inconsistency causes the building to collapse due to elastic loading. As a result, thorough research is required to achieve high performance and even poor configuration. In this work, the effect of vertical alignment and volume instability on multi-story buildings under elastic loading is investigated. Three RC building frames were selected and it is recommended to analyze all frame and modified frames. The ETABS analysis system is recommended to be analyzed by all parties to determine all migrations. In this study, 3-D frames of floors G + 20 are considered with the same height arrangement along the entire length and with a precise non-uniform configuration starting from the 9th floor. It is recommended that all previous frame responses be limited to all upload combinations. The response spectrum analysis method is designed to detect the lateral loads and floor settlements of all three frames due to earthquake loading and IS 1893 (Part 1): 2016 recommends dynamic analysis (direct dynamic analysis).**

Keyword: RCC, Irregularity, ETABS, IS 1893, G+20 storied, Earthquake

1. INTRODUCTION

Structural failure begins at weak points during an earthquake. The instability of matter, stiffness and geometry of the structure contribute to this vulnerability. Unusual buildings are buildings that have this suspension. Unusual buildings have a significant impact on urban infrastructure. One of the main reasons for structural failure during an earthquake is poor location. For example, a soft floor is the most significant collapse. Consequently, the impact of direct negative consequences on seismic activity is increasingly important. The differences in height and size give these structures variable elements that differentiate them from standard structures. (Thowdoju et al. 2016)

The problems of building materials can be attributed to their peculiar distribution of size, strength and durability. Analysis and design are extremely difficult when such structures are built at high altitudes. There are two kinds of defects.

A building is considered regular when its configurations are nearly symmetrical along an axis, and is said to be irregular when there is no symmetry and discontinuity in geometry, mass, or load-resisting materials. Torsional forces are amplified in an asymmetric arrangement. IS 1893: 2016 (Part 1) explains the building configuration concept for improved seismic performance of RC structures. In terms of the size and shape of the structure, arrangement of structural parts and mass, the configuration of the building is defined as regular or irregular. Irregularities are divided into two categories. 1) Horizontal irregularities include asymmetric planforms (L, T, U and F) or discontinuities in horizontal resistive elements such as entry corners, wide openings, cutouts and other modifications such as twisting, deformation and stress concentration. 2) Vertical irregularities refer to sudden changes in the strength, stiffness, geometry and mass of the structure in the vertical direction. The primary objective of this work is to investigate the response of irregular structures under dynamic loading. In this study, it is proposed to consider building frames with uneven cant and investigate the response and behavior of structures under earthquake and wind loads. For this purpose, three RC building frames are selected and it is recommended to assess all the frames that are considered and modeled. The ETABS analysis program is recommended for the study of all structures to obtain all displacements. G+20 In this study, multi-story 3-D frames with a symmetric height arrangement throughout the height and an asymmetric vertical configuration starting from the 9th floor are investigated. It is proposed to calculate the responses of all previous frames for all load combinations. A response spectrum analysis approach is proposed to estimate lateral loads and storey shears of all three frames due to seismic loading and IS 1893 (Part 1): 2016 approved dynamic analysis (linear dynamic analysis).

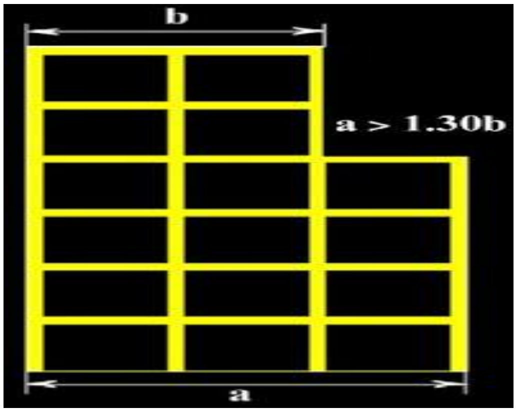


Fig 1 Vertical Geometric Irregularities in Building

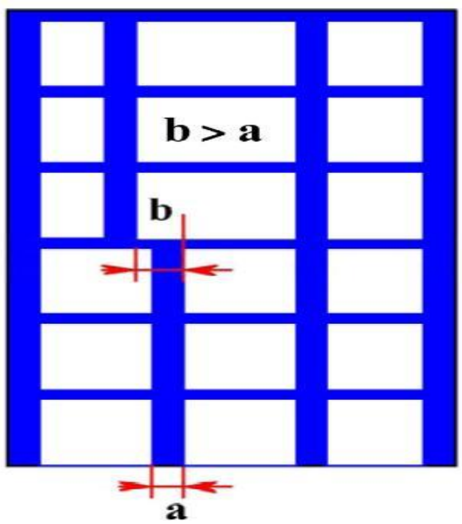


Fig 2 In-plane discontinuities in vertical lateral force-resisting element

A. Scope For Research

Irregular structures make up a large percentage of modern urban infrastructure. Because structures are never completely regular, designers must constantly assess the expected degree of irregularity and the effect of that irregularity on the structure during an earthquake. There is a need for research to develop a low-cost and effective lateral stiffness solution for highly seismically prone locations. For the optimization and design of high-rise buildings with different structural and frame systems that are subjected to seismic loading. To gain a better knowledge of the seismic behavior of buildings with vertical imperfections.

II. PROBLEM STATEMENT

The project study had two phases. Primary data was obtained through literature research, which included web searches and examination of e-books, manuals, codes, and journals. After the review, a problem statement is developed and three samples are selected for detailed research and analysis. This project is carried out in accordance with the flowchart below: The flowchart below provides an overview of the project layout. In addition, the models are examined for response spectrum analysis.

Table 1 Model Input Data

Number of Stories	G+20
Total Height Of building	61.9 m
Height of Stories	Base to Storey 1 – 1.5m Storey 2 to Storey 9 – 3.2m Storey 10 to Storey 15 -3 m Storey 15 to Storey 21 – 2.8 m
Dimension of building	55m X 55m
Size of Beam	300 x 550 mm
Slab Thickness	S150 mm
Location	Pune
Seismic Zone	Zone IV – 0.16
Response Reduction Factor	5.0
Importance Factor	1.2
Grade Of Concrete	M 30
Grade Of Reinforcing Steel	Fe500
Supports at base	Fixed
Diaphragm	Rigid
Load Description	DL-Dead Load LL-Live load – 3 KN SDL- Super Dead load - 1KN EQX- Earthquake in X direction EQXN- Earthquake in X Negative direction EQY- Earthquake in Y direction EQYN- Earthquake in Y Negative direction Response Spectrum
Load Combinations	1.2 (DL + LL + EQX) 1.2 (DL + LL + RS X)

III. MODELING

Table 2 Models Description

MODEL 1	Vertical Irregularity At One Side
MODEL 2	Vertical Irregularity At Center
MODEL 3	Vertical Irregularity At Corner

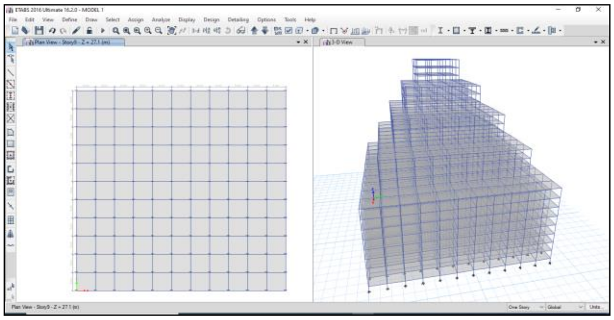


Fig 3 Model 1 Irregularity At One Side

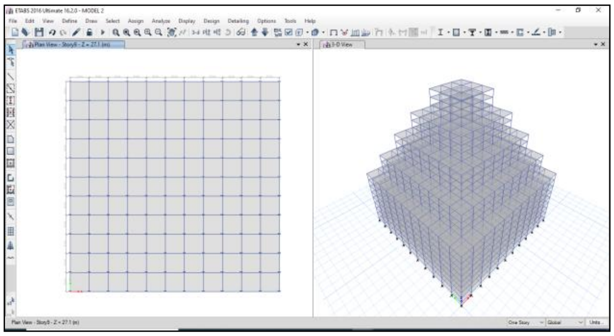


Fig 4 Model 2 Irregularity At Center

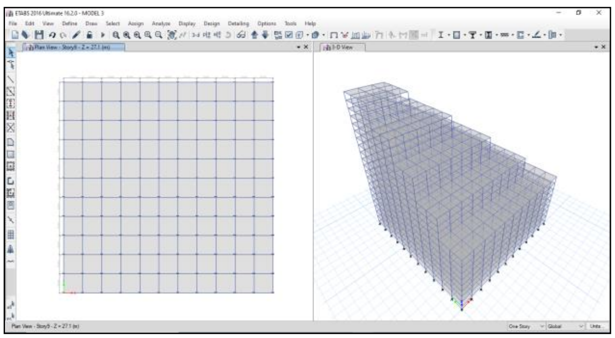


Fig 5 Model 3 Irregularity At Corner

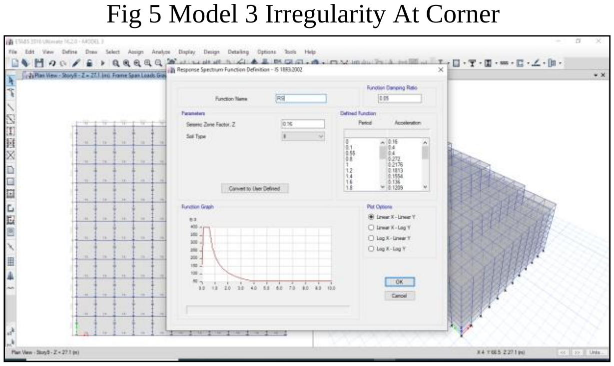


Fig 6 Response spectrum Case Added

IV. RESULTS AND DISCUSSION

A. Results For Response Spectrum Analysis With Similar Floor To Floor Height

In Our previous study different floor heights used for stiffness irregularity. The further analysis set Floor to Floor height 3m throughout the model, For model 1, model 2, model 3, And Analysis that models for responses spectrum analysis and compare time period.

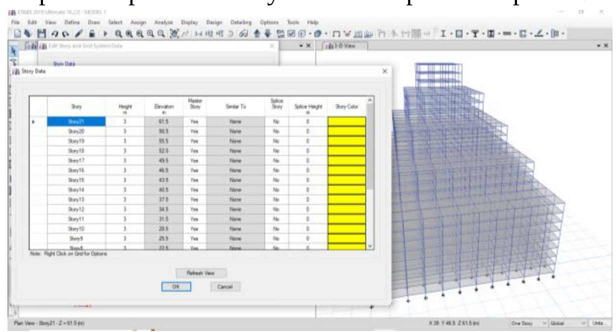


Fig 7 Model 1 with F to F Height 3

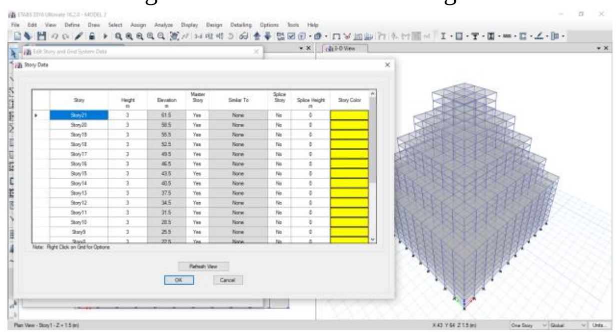


Fig 8 Model 2 with F to F Height 3

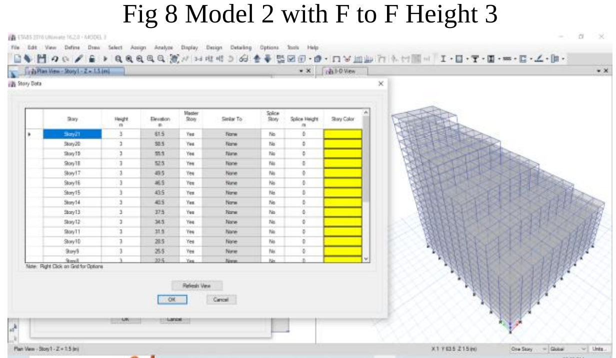
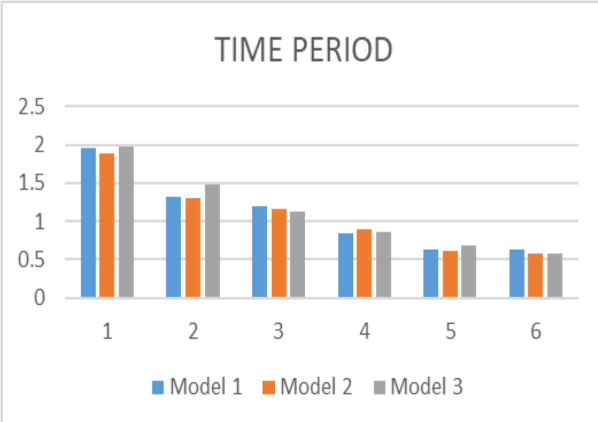


Fig 9 Model 3 with F to F Height 3

Table 3 Time Period

TIME PERIOD			
MODE NO	Model 1	Model 2	Model 3
1	1.952	1.892	1.977
2	1.32	1.309	1.476
3	1.205	1.158	1.124
4	0.852	0.891	0.863
5	0.633	0.623	0.693
6	0.627	0.579	0.588



Graph 1 Time Period

Time Period for Equivalent Static Analysis for model 2 is less than model 1 &3. The variation is found to be 5-10% less for model having Vertical Irregularity at Center than other 2 models. But as compare with models with different floor heights models with equal heights having less and economic results

V. CONCLUSION

The primary goal of this study is to analyse Vertical irregular high rise building using ETABS Dynamic analysis to determine time period, storey drift, displacements, and floor responses by using Different Vertical irregularities models and keeping the same mass of the entire building and the stiffness irregularities of the floors for the analysis. The study includes the involvement of 90% of the building mass in each primary horizontal direction of response as defined by IS 1893(Part-I)-2016 by full Quadratic Combination (CQC). In the study, high performance concrete is employed, as well as modern structural framings such as moment resistant frames. The structure has been evaluated for Equivalent Static and response spectrum analysis. According to FEA findings, storey share was found to be highest in the first storey and dropped to minimum in the top storey in all cases, while storey drift/ displacements were found to be minimal in the first storey and increased to the top storey in all cases. According to the research, model 2 (with vertical irregularity in the centre) is the most cost-effective model, followed by model 1 (with vertical irregularity on one side) and model 3 (with vertical irregularity at the corner). The following debate has brought all of the outcomes to a close.

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ii. ***IS 1893 : 2000 -*** *Criteria For Earthquake Resistant Design Of Structures*