International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 05 | May 2023 www.irjet.net p-ISSN: 2395-0072

"A REVIEW STUDY ON PUSHOVER ANALYSIS OF SYMMETRIC BUILDING ON FLAT & SLOPING SURFACE"

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Abstract – In this study the seismic response of a different storied reinforced concrete building is analysed by displacement-controlled pushover analysis. It is assumed to be located in different zone. This article provides a summary of the pushover analysis performance of flat & sloping ground building as determine by ATC-40 and FEMA-356. The pushover analysis based nonlinear static process(NSP), which is commonly used in real world application for building evaluation and design verification, has increased in popularity. However, the NSP can only respond in a single mode. Therefore, it applies to low rise buildings where the basic vibration mode dominates the behaviour. The pushover analysis done using ETABS. To evaluate the performance of the structure, it has been researched how dynamic features including base shear, roof displacement, mode shape, fundamental natural period, ductility ratio, and hinge status were induced in the building models.

Key Words: Seismic analysis, Pushover analysis, response spectrum, Time history analysis, Base shear, Displacement, Story shear.

1. INTRODUCTION

Earthquakes have historically occurred in the Indian subcontinent. Large quantities of hilly terrain may be found in India's north and north-east, which are classified as seismic zones III, IV, and V. in this area, it is inevitable that multistorey RC buildings will be resting on hill slopes. Because they are uneven and asymmetrical in vertical directions, building resting on sloping and flat surface have quite different dynamic properties from those of building resting on flat terrain.

In natural disasters like earthquakes, damage to or collapse of buildings and other man-made structures is the primary cause of catastrophes.

A reliable method for determining plastic hinge mechanism in structure and for predicting seismic demands is nonlinear response history analysis.

Pushover analysis is becoming more and more popular as a simple method for seismic performance evaluation of buildings. day by day people are attempting to study and use the method in analysis to RC frames, RC walls, steel and masonry structures recently.

Modal of pushover analysis comparing the peak inelastic response of a different storey building determined that the approximate procedure provides good estimates of displacement and story drifts, and identifies locations of most plastic hinges.

2. LITRETURE REVIEW

1. Comparative Pushover Analysis of High-Rise RCC Building Frame with and Without Vertical irregularities Author: Patil Sadhana M., D.N. Shinde

Journal: International Research Journal of Engineering and Technology

This study four vertical geometric irregular and one regular RC building frames are selected and it analyse all the frames by using ETABS. The seismic data and structural design data for all the frames is similar. To get performance point, the RC building frame with G+7 storeys is considered. There are 6 bays in each of the two directions. The standard storey height is 3 m, and the ground storey height is the same. The bay width is 3m in Y direction and 4.5m in X direction.

Comparison to a building frame without vertical irregularity, the base shear at the performance point is lower for a structure with vertical irregularity.

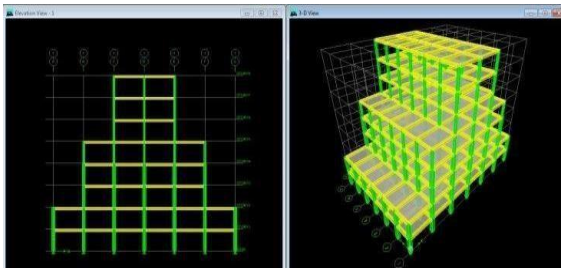
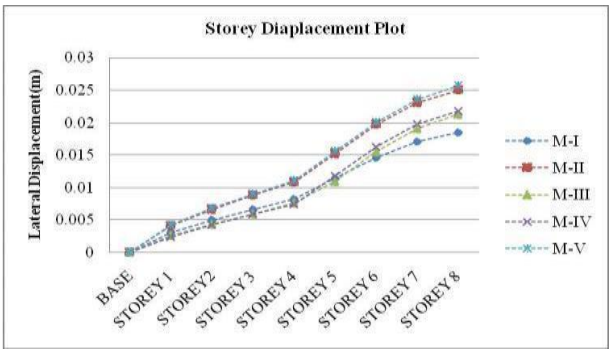


Fig.1 Elevation and 3D view of model M-II



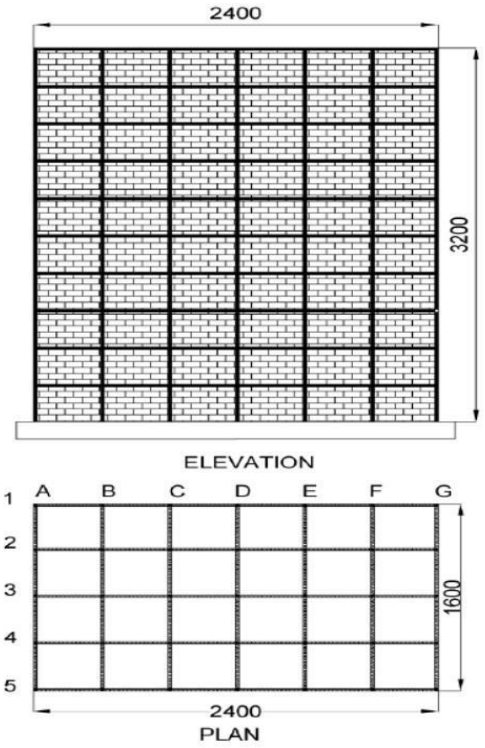
2. Pushover analysis of RC building.

Author: Dona Mary Daniel, Shemin T. John Journal: International journal of scientific and engineering research (2016)

In this study uses displacement-controlled pushover analysis to examine the seismic response of a reinforced concrete building with ten stories. It is thought to be in seismic zone III. Plastic hinge behaviour is modelled using the moment curvature connection in nonlinear analysis.

It was created as a result to model user defined hinges for beam and column section. The two ends of the beams and column sections, respectively, were given moment and interactive P-M hinges. The lateral forces were calculated and applied to the building in accordance with IS 1893(Part1):2002. To produce the pushover curve and the limiting displacement, top node displacement is increased incrementally up to that displacement.

The building used for analysis is a non-existing structure which is a ten storied RC building with floor-to-floor height of 3.2 m. The building is assumed to be located at seismic zone 3. The building is designed as a frame model with infill and constraints as fixed for the ground story columns.



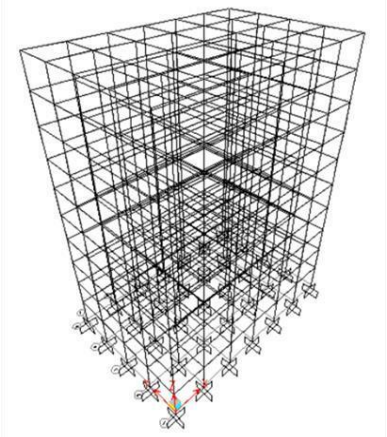


Fig.2 3D view of building

Load case	Maximum displacement (m)	Maximum base shear (kN)	Location of hinges					
			A to B	B to IO	IO to LS	LS to CP	C to D	Total
X-axis loading	0.1673	3884.855	1387	51	6	40	376	1860
Y-axis loading	0.2407	3534.256	1501	55	17	49	238	1860

3. Seismic Analysis of Building Resting on Sloping Ground with Soil Structure Interaction

Author: Ajit C. Suryawanshi, V. M. Bogar

Journal: International Research Journal of Engineering and Technology

In this study, on sloped land, displacement, story shear, story drift, and base shear of buildings have been compared using RCC structures both with and without consideration of the interaction of soil structures. When there is no SSI, RCC structures are frequently employed (soil structure interaction). Buildings on sloping land are analysed using the aforementioned factors both with and without consideration of soil structure interaction.

For the purpose of this study, G+19 story RCC framed buildings with and without SSI are designed in order to determine the behaviour of the structure during high seismic activity. The material properties are selected on the basis of displacement limitations and strength as per IS 1893.

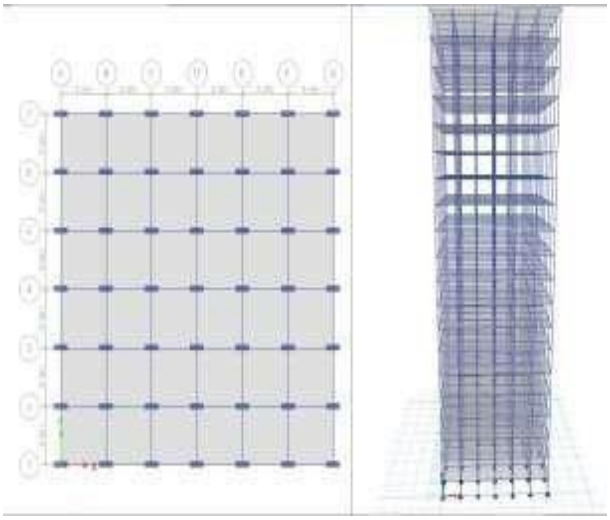


Fig.3 building on plane ground model.

This research paper deals with comparative study of behaviour of structures building frames with three geometrical configurations and different slope of ground.

Soil type	Shear modulus	Poison ratio
Hard soil	2700	0.25
Medium soil	451.1	0.35
Soft soil	84.5	0.48

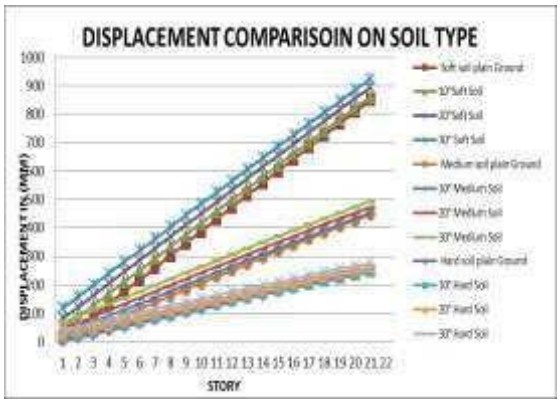


Fig.4 Displacement

4. A new lateral load pattern for nonlinear pushover analysis of high rising RC frame wall structures.

Author: Liu Weixing

Journal: IEEE (2010)

The purpose of this paper is to examine a study of a new lateral load pattern, named parabola pattern, is presented in this paper by a lot of time history analysis and pushover analysis performed to two high rising 17 storey and 22 storey RC frame buildings. The new lateral load pattern is used in the pushover analysis of two different buildings. its shaws that the new lateral load pattern is fit for the pushover analysis.

Nine strong ground motions are selected for time history analysis. The two buildings are performed time history analyses with the nine ground motions and pushover analyses with two lateral load patterns, Inverted Triangular and Rectangular patterns. The capacity curves from time history and pushover analyses.

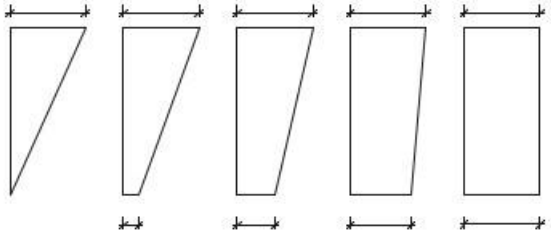


Fig. 5 Lateral load patterns

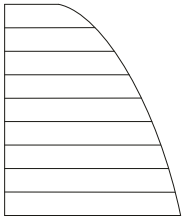
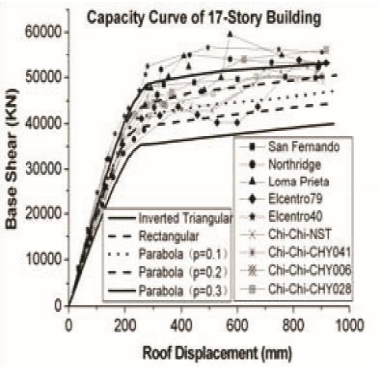


Fig. 6 Parabola lateral load pattern



5. Analysis and comparison of step back RC frame building on sloping strata and plain strata

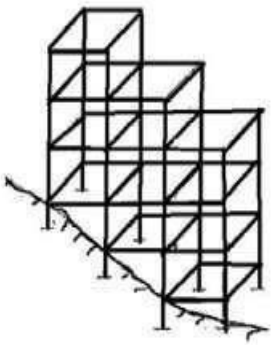
Author: Naveen Kumar S M, Vasipalli Vamsi Krishna Reddy

Journal: International journal of scientific and engineering research (2017)

In this study, the structures are typically built on flat surfaces, some of the construction work has started on sloping ground because flat surfaces are so hard to come by. Step back set back is the two different configurations for building on sloped ground. The investigation in this paper has focused on a G+10 storey RCC building. The model and analysis done using ETABS software.

Types of construction on slope:

1. Step back buildings on slope
2. Set back building on slope
3. Comparison of both



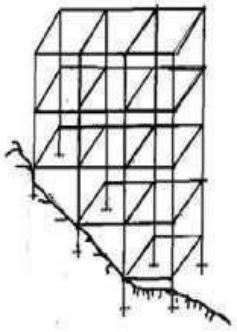
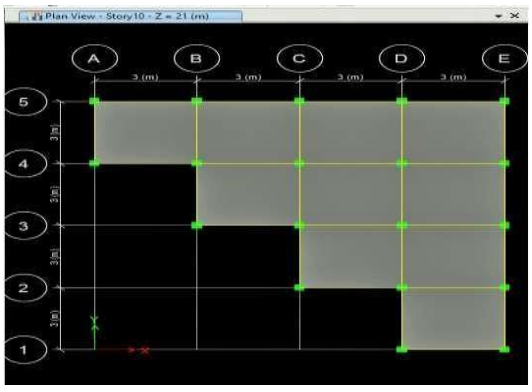


Fig.7 set back frame Fig.8 step back frame

In the combination of step back and set back building the design and architectural features are combined together and constructed.

In the present study, seismic analyses of structure models are carried out by using Equivalent Static Lateral Force Method. The simplest method of analysis is equivalent lateral load calculation procedure and this procedure involves less computational effort just because, the forces can be determined by on the basis of Code (IS 1893 (Part1): 2002) based fundamental period of structures with some practical converter.



OBJECTIVES OF WORK AND SCOPE OF WORK

3.2 Objectives of Work

- To analyse lateral loads on various building models**.**
- To inspect the structure's weakest areas so that they can be upgraded to improve the structure's performance.

- Constructing 3D building models with the help of ETABS software.
- To evaluate how buildings on sloped terrain operate.
- The thesis' main goal is to examine the impact of changes done to the modal features of symmetrical plan buildings during the pushover study.

3.3 Scope of Work

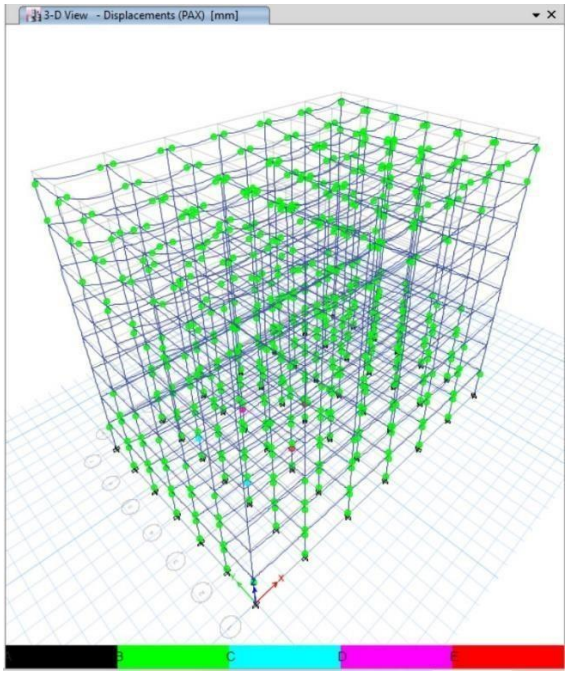
- Using the comparison of lateral displacements and member force support reactions, it will be attempted to compare the structural response of a steel frame under blast load and under no blast load.
- The computer program ETABS is used for modelling and analysis.
- The analysis of various structure is considered
- Followed IS 1893(Part1) 2002.
- Different zone and location are considered.
- To study the seismic response of multi-storey building with Soil Structure Interaction resting on sloping ground.

METHODOLOGY

1. For the study of the Seismic methods of analysis according to IS 1893(part1)2002.
2. Response spectrum analysis is carried out in software and gives appropriate solution for each plan configuration.
3. Time history analysis •
4. Step back buildings will be having their column in the ground.

HINGE STATUS AT PERFORMANCE POINT

The point at which the structure's capacity equals the demand placed on it by the seismic load is known as the performance point and is established using pushover analysis. The structure's condition at the performance point is used to gauge its performance. When the structure reaches its performance point, this can be done by examining the condition of the plastic hinges that are generated at various points throughout the structure. Therefore, it is crucial to investigate the condition of the structure's hinges at the performance point. How hinges are doing.



CONCLUSION

- In conclusion, pushover analysis is a useful technique for evaluating a structure's seismic performance. There are various methods that can be applied depending on the displacement, base shear, stiffness, and deformation capacity of a particular seismic element. The model studied is an example of how to analyse and evaluate the nonlinear static of structure.
- In this study the hinges are provided in all columns & beams. And all the hinges between B-C point.
- Pushover analysis is an ideal method to explore the nonlinear static behaviour of structure.
- The capacity curves from pushover analysis with the history analysis proves that the lateral load pattern fit for the pushover analysis of any RC structure.
- In present study, the displacement value is very much high on flat surface as compare to sloping surface.
- The soft story is very less for flat surface than sloping surface. The overturning moment generally decreases on sloping surface than compare to flat surface.

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