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Review on Performance Based of RCC Building

KEYWORDS
RCC Building, Seismic, Design, Performance

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ABSTRACT This Paper consists the review on the performance of the analysis of RCC building.Performance Based Seismic Engineering is the modern approach to earthquake resistant design. It is an attempt to predict the buildings with predictable seismic performance. In one sense, it is limit-states design extended to cover complex range of issues faced by earthquake engineers.This paper is an attempt to understand the basic fundamentals and procedures of Performance Based Analysis of R.C.C. buildings. The analysis was performed on new as well as existing R.C.C. buildings and the performance of buildings in future earthquake was obtained

I. INTRODUCTION

Many researchers have made attempts to evaluate the performance of the buildings by different methods. Seismic analysis methods of the structures can be characterized as, Seismic coefficient method and Dynamic Analysis. Seismic coefficient method is an equivalent static analysis considering a design seismic coefficient. The design seismic coefficients include factors such as importance factor, soil-foundation factor, response reduction factor and zone factor. In order to simplify the methods of analysis for determining earthquake effects on structures, codes of practice recommend seismic-coefficient method.

Dynamic analysis can be characterized as, Response Spectrum analysis for linear structures, Time history analysis for linear or non-linear Structures and Frequency domain method. The promise of performance-based analysis is to produce structures with predictable seismic performance. Performance based engineering is not new.

These geometric nonlinearities can become significant in frames, which are displaced laterally due to seismic movements or by wind loads. The interaction between the gravity load induced axial forces in the columns and the lateral displacements give rise to moments and forces in addition to those determined in a common "first order" analysis.

This additional effect is commonly referred as P▲ effects, where "P" refers to the gravity loading and "▲" the lateral displacements.

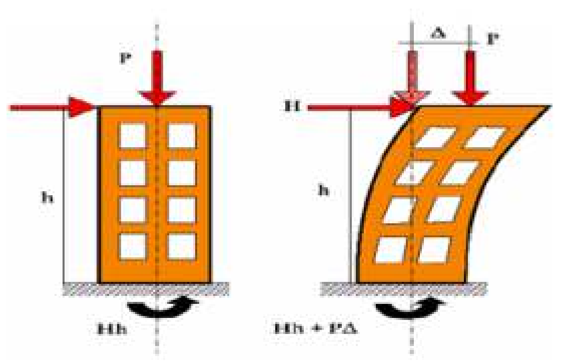

Fig 1: P ▲Effect

II. LITERATURE REVIEW

The literature review showed there is a lack of information Regardingpush over analysis and different seismic parameters over the building.
The general features of a few selected researches are shown below regarding performance based analysis of the building.

A) Seismic Analysis and Retrofit of Existing Multi-Storeyed Buildings in India

1) Amlan K. SENGUPTA, CHEMURU Srinivasulu Reddy, Badari Narayanan V T &Asokan A Performed seismic analysis of existing multistoreyed building.

Many existing buildings lack the seismic strength and detailing requirements of IS 1893:2002, IS 4326:1993 [2] and IS 13920: 1993 [3], because they were built prior to the implementation of these codes. This paper is part of a project, whose aim is to evolve methodologies to assess the seismic vulnerability of reinforced concrete (RC) three-to tenstoreyed, residential and commercial buildings, particularly those located in the urban areas of earthquake zones V, IV and III, and to propose retrofit measures for the structurally deficient buildings.

The building presented in this paper is a residential, ordinary moment resisting RC framed building, located in Zone III. Figure 1 shows the typical floor plan of the building. The building is a four storeyed building. The height of the roof is 13.1 m from the ground level. Plan dimensions of the building are 20.47m ×13.29m. The construction drawings specify that M20 grade of concrete (characteristic cube compressive strength is 20 N/mm2) and Fe 415 grade of steel (characteristic 0.2 percent proof stress is 415 N/mm2) were used for the construction.

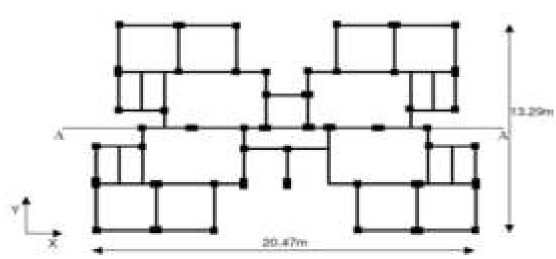

Fig 2: Typical Floor Plan of building showing column and beam location

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The stiffness for columns and beams were taken as 0.7 g EI , accounting for the cracking in the members and the contribution of flanges in the beams.Participation in both the directions. VxandVyare the components of EQ in X and Y directions, respectively. As B V was less than B Vx, the seismic force demands in the frame elements from response spectrum analysis were scaled up by a factor equal to the ratio of the two base shears (/) VB/ V .

	Without infill stiffness		With infill stiffness	
	V_x (kN)	V_y (kN)	V_x (kN)	V_y (kN)
Equivalent static method $(\overline{V_B})$				
EQ_x	554.6	-	746.2	-
EQ_y	-	528.5	-	711.1
Response spectra method (V_B)				
EQ	264.1	237.9	484.6	569.2
$\overline{V_B}/V_B$	2.10	2.22	1.54	1.25

Table 1: Comparison of Base Shears

Table shows the comparison of design base shears of the building, with and without infill stiffness. Vbis the base shear by equivalent static method. EQxand EQyrepresent the earthquake loads acting in the Xand Y directions, respectively. The base shear from response spectrum analysis (Vb) was calculated fromthe modal combination of first ten modes, by the SRSS method. These modes give more than 99% mass.

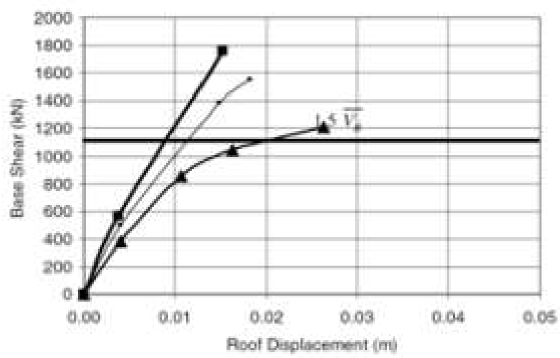

Fig 3: Push Over Curves for Existing and Retrofitted models

From the seismic evaluation it was determined that building needs retrofit to resist the design earthquake demand. To retrofit the building a number of possible retrofitting schemes were tried. Two schemes that are economically feasible are presented here.

RC – Control Concrete, CC-20 & CC-25, 20% and 25% replacement of coarse aggregate with sanitary ware waste respectively.

A retrofit strategy will only be successful when the new element is able to share the load as well as can deform along with the existing components of the building.The quality of construction for a successful retrofit scheme cannot be overemphasized. Any sort of patchwork will be a wasted effort.

B) Incorporation of Various Seismic Retrofitting Techniques For RC Framed Building Using SAP2000

2) V.S.R. Pavan Kumar.Rayaprolu1, P. Polu Raju2 carried out analysis for the RC framed building in SAP2000 Program. In this paper comprehensive review of materials and techniques used for seismic retrofitting of RC framed building located in seismic zone v is discussed briefly using SAP 2000 software. The document highlights a higher degree of damage in a five storied building is expected during an earthquake. If the seismic resistance of the building is inadequate then decision to strengthen it before an earthquake occurs depends on the building's seismic résistance and seismic deficient building should be adequately strengthened, in order to attain the desired level of seismic resistance.

In general, analytical models for the pushover analysis of frame structures may be divided into two main types: (1) Distributed plasticity (plastic zone) and (2) Concentrated plasticity (plastic hinge). Although the plastic hinge approach is simpler than the plastic zone, this method is limited to its incapacity to capture the more complex member behavior that involve severe yielding under the combined actions of compression and bi-axial bending and buckling effects.

S.No	Element	Size (mm)
1.	Beam	230x300 inner 230x350 outer
2.	Column	230x300 inner 230x350 outer
3.	Slab	130
4.	Walls	230

Table 2: Dimensional Parameters

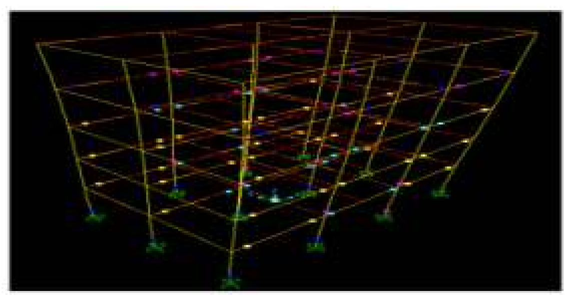

Figure 4: 3D Frame of Building in SAP2000

In figure.5 shows that both capacity and demand curves are intersected in between immediate occupancy and life safety zone. Such that building experiences moderate damage when subjected to pushover loads. For peak lateral load of 384.75 KN Plastic hinges formation starts with beam ends and base columns of lower stories then propagates to upper stories and continue with yielding of interior intermediate columns in the upper stories.

Figure 5: Pushover Curve

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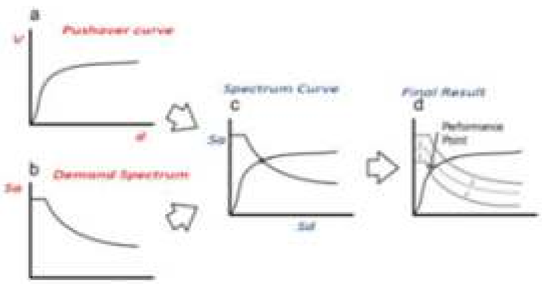
C) Seismic Assessment of an RC Building Using Pushover Analysis

RizaAinul Hakim, Mohammed SohaibAlama, Samir A. Ashourassessed an RC building using Push over analysis method. This study aims to investigate building performance on resisting expected seismic loadings. Two 3D frames were investigated using pushover analysis according to ATC-40. One was designed according to a design practice that considers only the gravity load and the other frame was designed according to the Saudi Building Code (SBC-301).

Most of existing buildings do not meet the current design standards due to design shortage or construction shortcomings. There are various reasons such as the lack of a national code, the noncompliance with applicable code requirements, the updating of codes, the design practices and changes in the use of buildings. Therefore, existing buildings should be evaluated regarding their capacity for resisting expected seismic effects before rehabilitation works.

Nonlinear dynamic analysis is a principally convenient approach. However, it is very complex and not practical for every design. Such analysis faces certain difficulties, such as the complexity of the three dimensional modeling structure, uncertainty of the structural properties, and the randomness of the ground motion data required for analysis.



Pushover Analysis requires the development of the forced deformation curve for the critical section of beams and column by using the guideline in. Such a curve is presented in Figure.

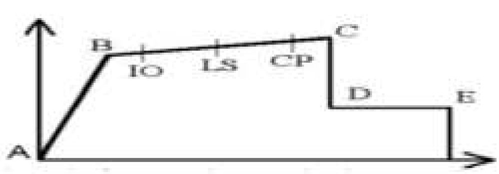


Figure 6: Typical Load Deformation Curve

Point A corresponds to the unloaded condition. Load deformation relation shall be described by the linear response from A to an effective yield B. Then the stiffness reduces from point B to C. Point C has a resistance equal to the nominal strength then a sudden decrease in lateral load resistance to point D, the response at reduced resistance to E, final loss of resistance.

The slope of the BC line is usually taken between 0 and 10% of the initial slope. The CD line corresponds to an initial failure of the member. The DE Line represents the residual strength of the member. These points are specified according to FEMA to determine hinge rotation behavior of RC members

Material	
Concrete	27.5 MPa
Steel	A615Gr60
Loading	
Self-weight	Automatically by Software
Dead load	2.7 kN/m²
Live Load	2.5 kN/m²
Wind Load	Not Considered
Modelling	
Element	Linear element for beam and column Shell element for slab
P-delta effect	Not considered
Diaphragm	Shell element for slab
Support	Fixed

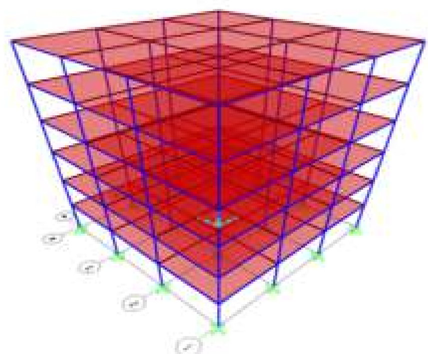


Figure 7: 3D Model in SAP2000

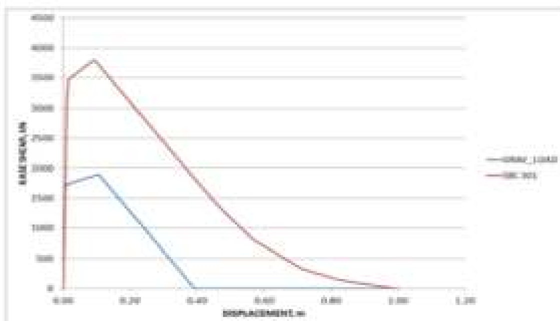


Figure 8: Pushover Curve

Pushover analysis can identify weak elements by predicting the failure mechanism and account for the redistribution of forces during progressive yielding. It may help engineers take action for rehabilitation work. The results show that design considering only gravity load is found inadequate. Therefore, a structural engineer should consider earthquakes in designing building.

D) PUSHOVER ANALYSIS FOR ASYMMETRIC AND SETBACK MULTI-STORY BUILDINGS

A. S. MOGHADAM1And W. K. TSO2performed push over analysis for asymmetric and set back multistory buildings. The procedure uses an elastic spectrum analysis of the building to obtain the target displacements and load distributions for pushover analyses. Then two-dimensional inelastic static analyses are conducted on the lateral load resisting elements of interest.

To illustrate the application and accuracy of the proposed procedure, the seismic responses of three seven-story buildings subjected to an ensemble of ten artificial ground motion records as input are computed. The plans of the buildings are similar (Figure 1). The first building is a

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reinforced concrete ductile moment resisting frame building. The building has a rectangular plan measuring 24m by 17m and story height of 3m. The ground motions are assumed to come from the Y-direction and the lateral load resisting elements in that direction consist of three identical ductile moment resisting frames

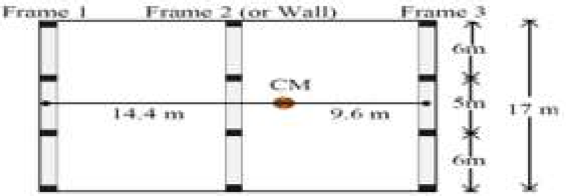

Fig 9 : Plan of Building

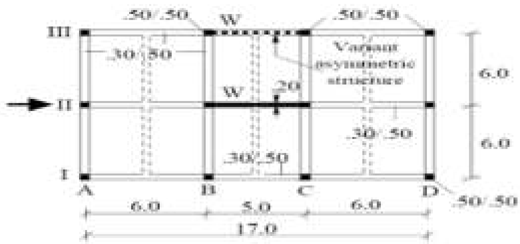

Figure 10: Response Spectra

A response-spectrum based pushover procedure is used to obtain seismic response estimates of three types of asymmetrical building systems. This procedure includes some of the three dimensional effects caused by the torsional responses. The main features of the procedure are the use of elastic response spectrum analysis of the building to obtain the target displacements and the load distributions used in the pushover analyses. In this procedure, there is no need to model the inelastic behaviour of all the elements in the building. It is sufficient to find the target displacements of the planes of interest and only model the inelastic behaviour of those elements for 2-D pushover analyses.

The use of load distribution resulted from response spectrum analysis in pushover analysis, improves the result for the frame building and deteriorates the results for the setback and wall-frame systems.

E) SIMPLE PUSH-OVER ANALYSIS OF ASYMMETRIC BUILDINGS

VOJKO KILAR and PETER FAJFAR carried out simple push over analysis of the asymmetric building. A simple method for the nonlinear static analysis of complex building structures subjected to monotonically increasing horizontal loading (push-over analysis) is presented. The method is designed to be a part of new methodologies for the seismic design and evaluation of structures. It is based on the extension of a pseudo three-dimensional mathematical model of a building structure into the nonlinear range.

In the paper the mathematical model, the base shear – top displacement relationships for different types of macro elements, and the step-by-step computational procedure are described. The method has been applied for the analysis of a symmetric and an asymmetric variant of a seven-story reinforced concrete frame-wall building, as well as for the analysis of a complex asymmetric 21-story reinforced concrete wall building.

In the case of a large and complex asymmetric building structure, the use of a general computer program is time-consuming and impractical (mainly in the definition of the model and in the interpretation and checking of the results) even if the analysis is restricted to statics. Therefore, some attempts have been made to study the basic features of the inelastic seismic response of asymmetric building structures

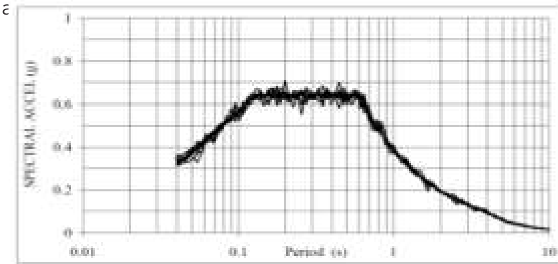

Figure 11: Plan of Building

The proposed simple procedure for the push-over analysis of building structures is capable of estimating several important characteristics of nonlinear structural behaviour, especially the real strength and global plastic mechanism. It also provides data about the sequence of yielding of different parts of the structure, and an estimate of the required ductilities of the different macroelements in relation to the target maximum displacement.

If a torsional plastic mechanism is formed the available strength of some macro elements cannot be fully exploited. Torsional rotations and the formation of a torsional mechanism strongly depend on the structural elements which resist loads in the direction perpendicular to the direction of the applied loading.

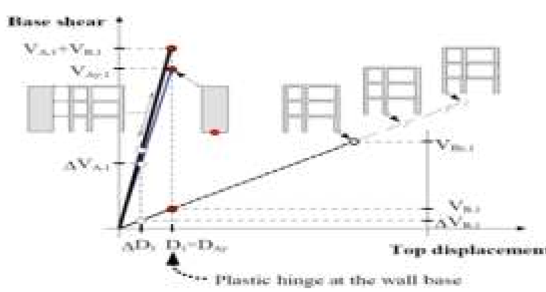

Figure 12: Pushover Curve

III. CONCLUSION

From the above research papers, Conclusion are made that up various methods of the nonlinear static analysis are studied out of which push over analysis is the accurate and efficient method of analysis yet some parameters are yet to be evaluated in it.

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