International Journal of Advance Research in Science and Engineering
Vol. No.5, Issue No. 12, December 2016
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

R.C FRAMES ANALYSIS BY USING PUSHOVER ANALYSIS CONSIDERING BAY WIDTH VARIATION

Prof. Deosarkar Manoj U.[1], Prof. Kenkar Kalyani S.[2],
Prof. Kadlag Vishwajeet A. [3]

[1] Assistant Professor, Department of Civil Engineering,
Dr. D Y Patil School of Engineering & Technology Lohgaon, Pune (India)
[2]Assistant Professor, Department of Civil Engineering,
Parvatibai Genba Moze College of Engineering, Wagholi, Pune (India)
[3] Assistant Professor, Department of Civil Engineering,
Dr. D Y Patil School of Engineering & Technology Lohgaon, Pune (India)

ABSTRACT

Most of the times analyses of structures are carried out by considering Most of the times analyses of structures are carried out by considering base of the structure as a fixed base. But we know that due to this assumption of fixity at base condition, the results obtained are affected from its actual results. From the above, while evaluating seismic structural behavior, the effect of soil structure interaction is important to get correct results. Therefore in this study various structures are analyzed by considering base of the structure as fixed base as well as for various flexible base conditions, which are categorized as medium soil and soft soil. Also the effect of variation in bay width is also taken into account. For analysis purpose in this study structures are considered from G+10 stories to G+20 stories at an interval of 5 stories. While assessing the seismic behavior of structure, the pushover analysis is employed and accordingly its effect in the form of failure hinge formulation is studied.

***Keywords:* Soil structure interaction, Pushover analysis, Hinge failure, Bay width variation, Fixed base, Flexible soil.**

I INTRODUCTION

Due to earthquakes many concrete structures have been severely damage or it may collapse. During earthquake the possibility of structural vulnerability to damage need to be identified with respect to safety requirements, so that new philosophy has been incorporate known as performance based design. It converts simplified linear elastic method into nonlinear technique i.e. pushover analysis.

The response of a structure subjected to seismicity is complex and it depends upon various parameters namely characteristics of ground motion, allowable deformation limits of the structure, strength of structural material, soil structure interaction etc. Till date most of studies have been carried out considering base of the structure as

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

a fixed, but it gives results with errors. Therefore soil structure interaction effect is incorporate to study the seismic behavior of various structures [3].

Plan dimensions of the structure are also very important parameter in analysis, due to increase in bay width of the structure percentage failure in structural members also goes on increasing.

II PUSH-OVER APPROACH

The pushover analysis is a nonlinear static analysis described in (Eurocode 8, 2003). In this method lateral force distribution is applied to the structure and monotonically increased. Plot of the total base shear versus roof displacement is then obtained which indicates any premature failure or weakness this is called capacity curve [4], as shown in Fig.1.The process is continued until a displacement at top of building reaches a level at which structure becomes unstable.

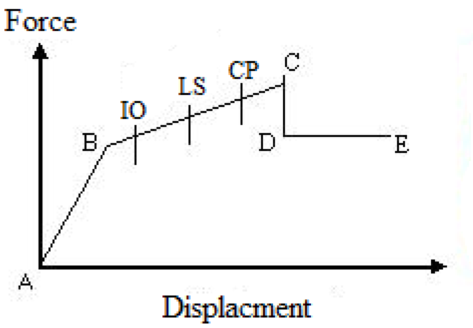


Fig.1 Capacity curve.

The seismic performance of structure is measured by the state of damage occurred under a certain level of seismic hazard. The state of damage is quantified by the drift of the roof and the displacement of the structure and it is given in various building performance levels as per guidelines [3].

2.1 Winkler approach

Winkler approach represents the soil medium as a system of identical but mutually independent, closely spaced, discrete, linearly behaving elastic springs. The effect of soil flexibility is suggested to be accounted through consideration of springs of specified stiffness's [1]. The stiffness along these six degrees of freedom is determined with help of G. Gazetas formula [5] and is shown in Table1.

2.2 Bay width variation

Bay width variation is also one of the important parameter while designing. The center to center distance between columns is responsible for stability of structure. Increase in bay width gives more number of hinge failures in most critical zones which are given by pushover analysis as per Eurocode8.

III PROBLEM FORMULATION

Building frame are design as per IS 456-2000 for its structural members and for earthquake forces IS 1893-2002 are used. Building frame is located in ZONE-III all earthquake parameters are as per IS 1893-2002 and material properties used are M-20 grade of concrete and Fe-415 for steel reinforcement. Plan and sectional elevation are given in Fig.4

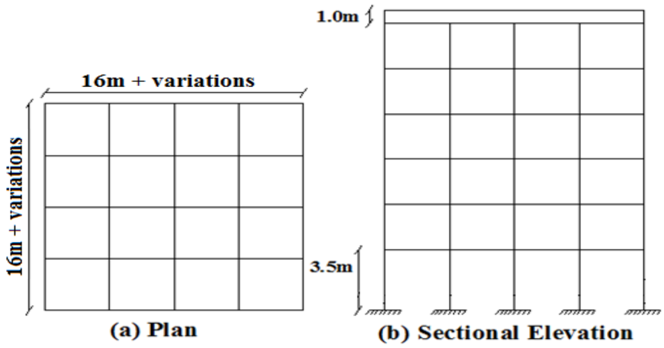


Fig.4 Plan and sectional elevation of building frame

Table.2 Structural members of building frames

Members	B1	C1	C2	C3	C4	C5
C/S	230x 340	230x 340	380x 380	550x 500	550x 625	650x 625

Where, B1=Sizes of beams and C1 to C5= Sizes of columns.

IV STUDY CARRIED OUT

Variation in base conditions of structure are consider viz. infinitely rigid fixed base with modulus of elasticity E=∞kN/m^2, medium soil with E=35,000 kN/m^2 and for soft soil with E=15,000 kN/m^2. Total numbers of frames considered in this study are three, G+10 stories, G+15 stories and G+20 stories. For the sake of comparison, fixed base condition is assumed to be datum and other two base conditions viz. medium soil and soft soil are varying accordingly.

Table.3 Floor wise assignment of structural members to various structures

Structural frames	Floors assigned				
	C1	C2	C3	C4	C5
G + 10	9th,10th	6th,7th,8th	3rd,4th,5th	G.F,1st,2nd	----

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

G + 15	12th,13th,14th,15th	8th,9th,10th,11th	4th,5th,6th,7th	G.F,1st,2nd,3rd	----
G + 20	16th,17th,18th,19th,20th	12th,13th,14th,15th	8th,9th,10th, 11th	4th,5th,6th,7th	G.F,1st,2nd,3rd

Similarly for change in base width criteria number of hinge failure is also changing considerably, in this same bay width and different end conditions are compare with each other. 4.0m is the first bay width considered for analysis purpose further this bay width changes to 4.5m and 5.0m respectively.

Structural members like beams, columns are assigned in a group of floors as shown in Table.3. In this B1 shows beam sizes, geometry of beams are kept constant throughout the structure. C1 to C5 shows various column sizes and they are assigned in a group of floors to various structures.

V RESULTS AND DISCUSSION

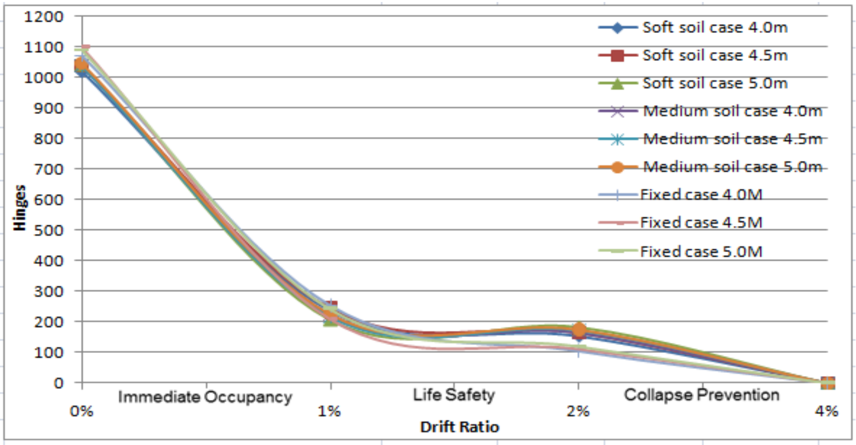
In this study number of hinges versus drift ratio graphs are plotted to observe performance of structure according to various base conditions and bay width variations. For analysis purpose structures are considered at an interval of 5 stories from G+10 stories up to G+20 stories. Fixed base condition of structure is kept as a datum and to evaluate soil structure interaction phenomenon fixed base of structure is replaced by flexible base viz. medium soil and soft soil. To check for bay width variations 4.0m bay width is consider as a datum and it is changes to 4.5m and 5.0m respectively. Results obtained by comparing various base conditions and bay width are as follows.

5.1 Hinge variations in G+10 structure

In the present study Graph.1 shows variation in number of hinge failures according to base condition and bay width of structure, fixed base and 4.0m bay width of structure is kept as a datum and other two cases are compare with datum. For fix base case with bay width 4.0m number of hinge failure is in LS zone and it is 105 in number as bay width changes to 4.5m and 5.0m number of hinge failure increase by 4.00% and 7.79% respectively. Similarly for medium soil case with bay width 4.0m number of hinge failure is in LS zone and it is 165 in number as bay width changes to 4.5m and 5.0m number of hinge failure increase by 0% and 6.16% respectively. And for soft soil case with bay width 4.0m number of hinge failure is in LS zone and it is 169 in number as bay width changes to 4.5m and 5.0m number of hinge failure increase by 6.38% and 13.56% respectively.

From all above we can conclude that there is increase in number of hinges with increase in bay width of structure, and performance of structure is more vulnerable towards danger.

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

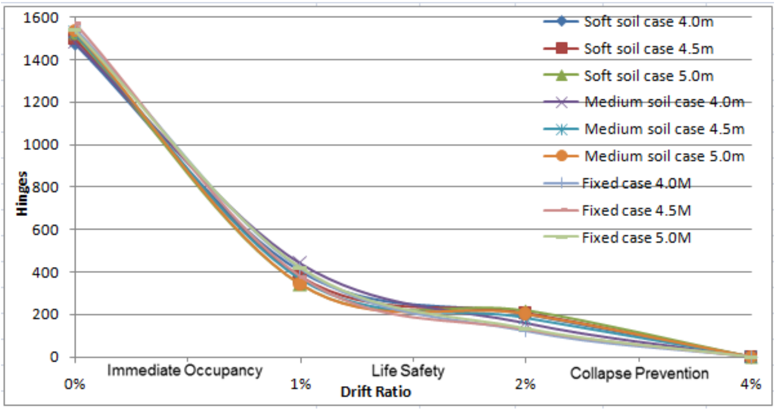


Graph.1 Variation in hinges for G+10 structure

5.2 Hinge variations in G+15 structure

In the present study Graph.2 shows variation in number of hinge failures according to base condition and bay width of structure, fixed base and 4.0m bay width of structure is kept as a datum and other two cases are compare with datum. For fix base case with bay width 4.0m number of hinge failure is in LS zone and it is 120 in number as bay width changes to 4.5m and 5.0m number of hinge failure increase by 8.98% and 10.53% respectively. Similarly for medium soil case with bay width 4.0m number of hinge failure is in LS zone and it is 157 in number as bay width changes to 4.5m and 5.0m number of hinge failure increase by 0.19% and 25% respectively. And for soft soil case with bay width 4.0m number of hinge failure is in LS zone and it is 200 in number as bay width changes to 4.5m and 5.0m number of hinge failure increase by 3.0% and 8.73% respectively.

From all above we can conclude that there is increase in number of hinges with increase in bay width of structure, and performance of structure is more vulnerable towards danger.



Graph.2 Variation in hinges for G+15 structure

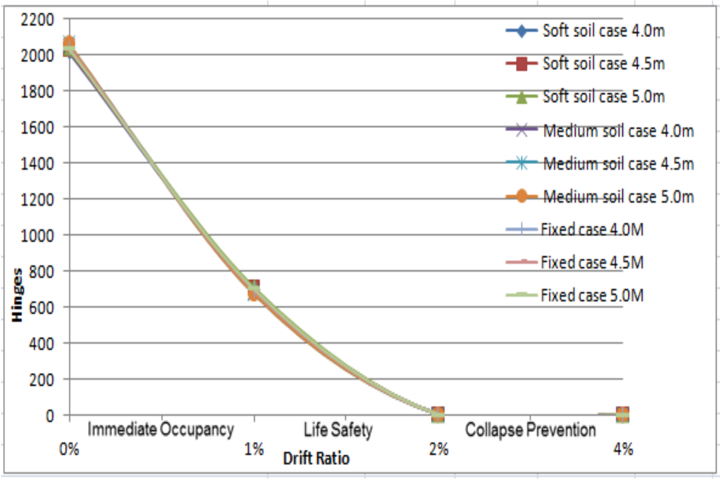
5.3 `Hinge Variations In G+20 Structure-

In the present study Graph.1 shows variation in number of hinge failures according to base condition and bay width of structure, fixed base and 4.0m bay width of structure is kept as a datum and other two cases are

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

compare with datum. For fix base case with bay width 4.0m number of hinge failure is in LS zone and it is 685 in number as bay width changes from 4.0m to 4.5m and 5.0m number of hinge failure increase by 1.10% and 2.53% respectively. Similarly for medium soil case with bay width 4.0m number of hinge failure is in LS zone and it is 694 in number as bay width changes from 4.0 to 4.5m and 5.0m number of hinge failure increase by 0.75% and 1.99% respectively. And for soft soil case with bay width 4.0m number of hinge failure is in LS zone and it is 699 in number as bay width changes from 4.0 to 4.5m and 5.0m number of hinge failure increase by 0.69% and 1.79% respectively.

From all above we can conclude that there is increase in number of hinges with increase in bay width of structure, and performance of structure is more vulnerable towards danger.



Graph.3 Variation in hinges for G+20 structure

From all above cases it is observed that as base or bay width of structure changes in intervals of 0.5m from 4.0m to 5.0m, nature of hinge failure goes on increasing and performance of structure goes on decreasing.

VI CONCLUSIONS

While assessing the seismic behavior of structure in the form of hinge failure employing the pushover analysis, following conclusions are drawn

- It is observed that as bay width of structure goes on increasing number of failure hinges are increasing.
- It is observed that as the bay width changes from 4.0m to 4.5m percentage increase in failure hinge formation is in the range of 01% to 08% for all three types of soils.
- As the bay width changes from 4.0m to 5.0m percentage increase in failure hinge formation is in the range of 02% to 15% for all three types of soils.
- Percentage hinge failure goes on increasing as the number of storey increases.

REFERENCES

[1] KoushikBhattacharya, Sekhar Chandra Dutta (2004) “Assessing lateral period of building frames incorporating soil-flexibilty” Journal of Sound and Vibration 269 (2004) 795-821.

[2] Sekhar Chandra dutta, Ranaroy (2002) “A critical review on idealization and modeling for interaction among soil-foundation-structure system” Computer and structures 80 (2002) 1579-1594.

[3] M.Mouzzoun, O.Moustachi, A.Taleb, S.Jalal (2013) “Seismic performance assessment of reinfoeced concrete buildings using pushover analysis” IOSR Journal of Mechanical and Civil Engineering, ISSN: 2278-1684 Vol.5, Jan.–Feb 2013, PP 44-49.

[4] Taner, Mustafa (2007) “Seismic performance assessment of reinforced concrete structuters” Deu Muhendislik Fakultesi Fen Ve Muhendislik Dergisi Clit: 9 Sayi: sh. 63-76 Mayis 2007.

[5] Kadlag V. A (2014) “Pushover Analysis of R.C Frames Considering Soil Structure Interaction”, International Journal of Current Engineering and Technology, E-ISSN 2277 – 4106, P-ISSN 2347 – 5161.

[6] “Applied Technology council-40” (1996).

[7] “Federal Emergency Management Agency-356” (2000).