iJRASET

International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 Issue: III Month of publication: March 2017

DOI: <http://doi.org/10.22214/ijraset.2017.3177>

www.ijraset.com

Call: ☎ 08813907089

E-mail ID: ijraset@gmail.com

Non-Linear Dynamic Analysis of RC-Framed Structure

Prof. Ravi M. Desai¹, Omkar J. Parkar², Tanvi K. Sajane³, Snehal N. Nirmalkar⁴, Prathamesh U. Shinde⁵

¹Assistant Professor (Civil Engg. Department), ^{2,3,4,5}Students (Final year B.E. Civil Engg.)

Sanjay Ghodawat Institutions, Atigre, Shivaji University, Kolhapur, India

Abstract: In this earthquake prone world, design and construction of earthquake resistant structure has greater value. In generally constructed buildings, masonry in-fills are non-structural elements and their stiffness are not considered which lead to dangerous design. If masonry infill walls are constructed as secondary elements then it act as constituent part subjected to seismic load. IN this paper, the earthquake response of RC-Framed structure is studied by manual calculation and with the help of SAP 2000. This paper will provides complete guideline for time history analysis of RC-Framed structure.

Keywords: Joint Displacement, Storey Drift, Non-linear Analysis, Time History, Base Shear.

I. INTRODUCTION

Due to increase in population there is high demand of tall buildings. Earthquakes have potential to damage the tall buildings. Therefore it is need of designing the building by considering the earthquake loads. Nowadays it has become a need of analyzing the beam for various earthquake intensities. Earthquake intensities vary with respect to their location.

(1)SAP 2000 (Software Analysis Program) is leading software which is used to design and analysis of any structure. Many design company's use this software for their project design purpose. SAP 2000 offers the various time history of various intensities which could be applied in analyzing of a building. So, the paper mainly deals with time history analysis of RS-Framed Structure using SAP-2000 software and comparing it with manual calculations. RC stands for Reinforced Concrete Structure.

A. Case Study Details

In this analysis low rise, mid-rise and high rise buildings are considered. A building frame of G+3, G+8, G+12 are considered. It consists of 4 bays along x direction and 2 bays along y direction. The spacing along x and y direction is 5 meters. Heights of each model are 10.2m, 22.2m, 34.2m.

- 1) **Design Data:** Floor to floor height = 3m, Column Size = 600mm*450mm, Beam Size= 450mm*450mm, Depth of Slab = 150mm, Frame Type = OMRF, Location = Pune, Seismic Zone =III, Type of soil = Hard soil Type I, Thickness of wall = 0.23m, Dead Load = 1KN/m², Live Load =2.5KN/m², Wall Load = 1KN/m², Floor Finish Load = 1KN/m², Roof Load = 1KN/m², Live Roof Load = 1KN/m²
- 2) **Description of Building Frame:** No. Bays along X axis : 4, No. Of bays along Y axis : 2, Spacing along X axis : 5m, Spacing along Y axis : 5m, Story height: 3m, No. Of floors: G+3, G+8, G+12, Size of column : 600mm x 450mm, Size of beam : 450mm x 450mm, Slab : 150mm thick

Fig.1 Plan OF Building

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

ELEVATION OF G+3

ELEVATION OF G+8

ELEVATION OF G+12

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

G+12	Y	0.027	35332.55	953.97
------	---	-------	----------	--------

D. Software Analysis

Table-2 Software Calculated Base Shear

MODELS	BASE SHEAR BY SOFTWARE(KN)	
	EX	EY
High Rise G+12	429.476	414.380
Mid Rise G+8	624.082	542.392
Low rise G+3	665.043	643.206

III. COMPARISON OF JOINT DISPLACEMENT

A. G+3 Storey

1) TH-X:

Table-3 Joint Displacement in X-Direction

JOINT	JOINT DISPLACEMENT(M)		
	ALTANDENA	HOLLISTER	NEWHALL
1	0	0	0
2	0.65668	0.5908399	0.096606
3	0.742962	0.6768483	0.177661
4	0.858279	0.6981787	0.230574
5	0.986126	0.7341545	0.355206

Fig.2 Joint Displacement in X-Direction for G+3

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

2) *Th-Y:*

Table-4 Joint Displacement in Y Direction

JOINT	JOINT DISPLACEMENT(M)		
	ALTANDENA	HOLLISTER	NEWHALL
1	0	0	0
2	0.516742424	2.32436	1.281
3	0.872348485	5.8406	3.2981
4	1.480681818	5.98749	3.5412
5	2.590348485	6.66734	5.39

Fig.3 Joint Displacement in Y-Direction for G+3

B. *G+8 Storey*

1) *TH-X:*

Table-5 Joint Displacement in X Direction

JOINT	JOINT DISPLACEMENT(M)		
	ALTANDENA	HOLLISTER	NEWHALL
1	0	0	0
2	0.01995	0.07726	0.04785
3	0.16071	0.19624	0.14644
4	0.31031	0.23974	0.29737
5	0.40449	0.34864	0.42819
6	0.46255	0.55514	0.50255
7	0.54574	0.69084	0.59119
8	0.65186	0.78997	0.71435
9	0.72016	0.9237	0.85245

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Fig.4 Joint Displacement in X-Direction for G+8

2) *Th-Y:*

Table-6 Joint Displacement in Y-Direction

JOINT	JOINT DISPLACEMENT(M)		
	ALTANDENA	HOLLISTER	NEWHALL
1	0	0	0
2	0.05725	0.08994	0.04958
3	0.14959	0.17353	0.16683
4	0.28012	0.25982	0.29491
5	0.3512	0.38506	0.34004
6	0.37196	0.45852	0.48312
7	0.4384	0.62506	0.52441
8	0.54218	0.67198	0.626
9	0.6465	0.75655	0.78268

Fig.5 Joint Displacement in Y-Direction for G+8

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

C. G+12 Storey

1) Th-X:

Table-7 Joint Displacement in X Direction

JOINT	JOINT DISPLACEMENT(M)		
	ALTANDENA	HOLLISTER	NEWHALL
1	0	0	0
2	0.0967	0.0843	0.06316
3	0.12842	0.11659	0.11068
4	0.17147	0.18699	0.15634
5	0.23988	0.24896	0.21353
6	0.29448	0.30588	0.28306
7	0.36193	0.38542	0.35286
8	0.43897	0.46987	0.43395
9	0.54878	0.51235	0.4939
10	0.54942	0.59366	0.52644
11	0.65147	0.68784	0.56347
12	0.71525	0.74699	0.62765
13	0.82549	0.85421	0.68352

Fig.6 Joint Displacement in X-Direction for G+12

2) Th-Y:

Table-8 Joint Displacement in X Direction

JOINT	JOINT DISPLACEMENT(M)		
	ALTANDENA	HOLLISTER	NEWHALL
1	0	0	0
2	0.01181	0.0646	0.02428
3	0.11981	0.1457	0.13381
4	0.18194	0.21366	0.1936
5	0.26996	0.29687	0.24196
6	0.31163	0.35612	0.30467
7	0.3933	0.42987	0.38536
8	0.45359	0.49639	0.44564
9	0.53944	0.55649	0.51628
10	0.61408	0.63988	0.64756
11	0.69411	0.7136	0.7116
12	0.74324	0.78639	0.81749
13	0.84672	0.85366	0.88282

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Fig.7 Joint Displacement in Y-Direction for G+12

D. Modal Analysis

Table 9: Modal Analysis

Joint	Ux Sum	Uy Sum	Rz Sum
1	0	0.78772	0.43577
2	0	0.78772	0.67752
3	0.7815	0.78772	0.7854
4	0.7815	0.88613	0.84005
5	0.7815	0.88613	0.8693

E. Time Period

NO.OF STOREY		SOFTWARE	MANUAL
G+3	X ₁	0.454	0.2 T _X
	X ₂	0.134	
	Y ₁	0.533	0.29 T _Y
	Y ₂	0.162	
G+8	X ₁	0.3280	0.45 T _X
	X ₂	0.09584	
	Y ₁	0.3849	0.63 T _Y
	Y ₂	0.11610	
G+12	X ₁	2.07	0.69 T _X
	X ₂	0.66	
	Y ₁	2.32	0.97 T _Y
	Y ₂	0.747	

IV. RESULT AND DISCUSSION

Graphical representation of variation in result as shown in the figure 5 – figure 11. The similar variation in seismic response namely joint displacement with intensities X and Y direction were seen in the graph.

Time period calculated by IS code method and by software is recorded. Modal mass participation factor is being recorded for the structure.

V. CONCLUSION

Based on the analysis and design of multi-storied building the following conclusions are made

- Codal empirical formula to calculate time period is less compare with time period by modal analysis,imposing higher spectral acceleration which results in conservative design.
- Modal mass participation factor for the modal in Y direction is higher compare with in X direction, indicating that this is the

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

weak direction for the response during earthquake.

- C. Modal mass participation in the torsion mode shows significant contribution and this is due to unsymmetry plan of building
- D. Base shear for low rise building is observed to be higher than tall building showing that low rise building are more stiff during earthquake.
- E. Due to record to record variability, the deformation responses for the three ground motions are different for the building in X and Y direction.
- F. HOLLISTER ground motion record gives maximum responses and might be because this ground motion is having higher PGA, higher frequency content and longer period.

VI. ACKNOWLEDGEMENT

The author thankfully acknowledge to Mr. Yogesh Jadhav (P.G. student), Mr. Desai Ravi (Guide), and Dr. S.M. Shiyekar (HOD, Department of Civil Engineering), Sanjay Ghodawat group of Institutions, Atigre, Kolhapur, Maharashtra.

REFERENCES

- [1] Agarwal Pankaj, Shrikhdnd Manish, "Earthquake resistant design of structures", PHI learning private limited, New Delhi, 2009.
- [2] Mahesh N. Patil, Yogesh N. Sonawane, "Seismic Analysis of Multistoried Building" International Journal Of Engineering and Innovative Technology (IJEIT) ISSN:2277-3754, Volume 4, Issue 9, March 2015.
- [3] A S Patil, P D Kumbhar, "Time History Analysis of Multistoried RCC Buildings for Different Seismic Intensities" International Journal of Structural and Civil Engineering Research ISSN 2319-6009 Vol.2, No.3, August 2013.
- [4] Balaji U.A, Selvarasan M.E.B, "Design and Analysis of Multi-Storeyed Building Under Static and Dynamic Loading Conditions Using ETABS" International Journal of Technical Research and Application e-ISSN: 2320-8163 Volume 4, Issue 4(July-Aug, 2016), PP.1-5.
- [5] Ibrahim Khaleel, Lingaraj Shastri, Lokesh G., "A Study on Influence of Masonry Infills and Shear Wall on the Seismic Performance of R.C Framed Building" International Journal of Engineering Sciences & Research Technology (IJESRT) ISSN:2277-9655, 4(12): December, 2015, PP.744-756.
- [6] IS: 1893(Part-I) 2002 (2002): Criteria For Earthquake Resistant Design of Structures, Part-I General Provisions and Buildings, Fifth Revision, Bureau of Indian Standards, New Delhi.
- [7] Murthy C.V.R, Learning earthquake design
- [8] Dalal Sejal P., Vasanwala S.A., Desai A.K. (2011) "Performance based seismic design of structure: A review", International Journal Of Civil And Structural Engineering, Volume 1, No 4 Mohammed S. Al-Ansari (2011), "Formulating building response to Earthquake loading", International Journal Of Civil And Structural Engineering Vol. 2, No 1.
- [9] Peter Fajafar M.EERI (2000) "A non linear analysis method for Performance based seismic design", Earthquake spectra, vol.16, no.3, pp 573-592

10.22214/IJRASET

45.98

IMPACT FACTOR:
7.129

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)