International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

Review Paper on Pounding Analysis of Non-Structure Element in Adjacent Building

Prabhakar kumar[1], Jitendra Yadav[2]

[1,2]*IES Institute of Technology and Management Bhopal, India*

Abstract - Pounding is very destructive phenomena. Due to which, during earthquake, strong ground motion, the acceleration at pounding level considerably increases and creates additional pounding force which causes major structural collapse or failure of structure.

This paper deals with the study of effects on non-structural element of building due to pounding during an earthquake. Response spectra method and time history analysis has been done for evaluating the pounding effects on different model of building when subjected to different ground acceleration. The result of study has shown the effect of earthquake on adjacent building in pounding and no pounding case for different floor level of non-structural element.

Keywords: SAP 2000, earthquake, pounding, non-structural element and Peak ground acceleration.

1. INTRODUCTION

Experiences of past and current earthquake-collapse have well established pounding as one of the main causes of structural damages in buildings, constructed very close to each other or without any gap at all. Pounding, which is a collision between adjacent buildings during an earthquake, commonly occurs due to their different dynamic characteristics, adjacent buildings vibrate out of phase and there is insufficient seismic gap between them. This situation can easily be seen in metropolitan cities where buildings have been constructed very near to each other due to very high population density and lack of knowledge about pounding and its consequences.

In case of pounding, during strong ground vibration, the acceleration at pounding level considerably increases and generates impact force which causes structural damages or sometime results into building collapse. And to avoid this situation of pounding, regulations of minimum seismic gap between buildings have been formulated but it is often seen that these regulations are neither followed by landowners nor strictly implemented by respective governments body. This leads to a situation like century City(USA) earthquake (1992) where, 45% of 340 damages or severely damaged buildings are cause of pounding only. That is why proper seismic gap is provided between newly constructed building and I.S code guidelines should must be followed. But for old adjacent buildings reliable techniques are used to control damages during earthquake like friction damper, concrete shear wall or rigid steel bracing must be used for structural, non-structural safety and life safety.

To avoid pounding different countries in all over the world have adopted their own codal specification to avoid pounding.

2. LITERATURE REVIEW

A. Shehata E. Abdel Raheem (2008), have studied the effect of impact using linear and non-linear contact force model for different separation distances and compared with nominal model without pounding consideration. The results were illustrated that acceleration and shear at various story levels, produced during pounding, were greater than those obtained from the no pounding case. He also illustrated that pounding was especially harmful for equipment or secondary systems having short periods due to amplified acceleration response at pounding level.

B. K. Kasai, V. Jeng(1994) were studied the pounding effects in Loma Prieta earthquake and found that a rigid adjacent building case provided the results similar to those from a relatively heavy flexible adjacent building case. It was established in their study that peak floor acceleration could be more than 10 times those from the no-pounding case.

C. R.C. Barros and S.M. Khatami (2010), have studied the effect of different link elements such as GAP element of SAP2000, Lessloss element and Kelvin-Voight element for simulating the pounding effect when models were subjected to three different ground motions of Kobe earthquake, Loma Prieta earthquake and Chi-Chi earthquake. They concluded that high lateral displacement can cause a strong impact force between two neighbouring buildings. They also showed that the impact force evaluated using Kelvin-voight is higher than Lessloss element and gap element of SAP2000.

D. Chetan J. Chitte, Hemraj R. kumavat (2012) have studied the variation in the responses of adjacent structures due to pounding, when they subjected to near-source ground motion and far-source ground motion. They concluded that the displacement in structure when it subjected to near-source ground motion was much higher than that of far-source ground motion. Therefore, the pounding effect for same seismic gap would be larger in case of near-source ground motion than the case of buildings subjected to far-source ground motion.

E. Robert Jankowski (2004) has studied the fundamental problem concerning the application of non-linear analysis, its viability and limitations in calculating the seismic gap between the buildings. To simulate the seismic behaviour of structure for his research, he used elastoplastic multi-degree of freedom lumped mass models and to model collision, he used non-linear viscoelastic impact elements. The study established the fact that the pounding has considerable effect on the behaviour of adjacent structures.

F. Arash Rezavani and A. S. Moghadam (2006) have illustrated various methods for mitigation of pounding effect on adjacent buildings during earthquakes. Increasing seismic gap between neighbouring buildings, linking the two adjacent buildings together at different floor levels such that they could move together and incorporation of impact absorbing materials like dampers, were main recommendation they proposed for mitigating the pounding effects on buildings during earthquake.

G. Chenna Rajaram, Pradeep kumar Ramancharla (2014) have studied the feasibility of codal provisions of various countries regarding minimum seismic gap required between adjacent buildings when buildings subjected to different ground motions such as Parkfield, Northridge, Petrolia, El Centro etc. They illustrated that the duration of strong ground motion intensified with an increment in magnitude of ground motion. Similarly they also concluded about the seismic gap between adjacent buildings that it increased with increment in PGA value of ground motion.

H. S. A. Anagnostopoulos (1998) has illustrated the pounding effects in his study based upon the evidences from the past earthquakes and of the results from numerical and theoretical studies presented. He also concluded that theoretically when two buildings of similar masses if subjected to pounding during an earthquake, the response of the stiffer building would be amplified and of the softer building would be deamplified but practically the amplification would be inconsiderate for the buildings of same height.

I. Bipin Shresta (2015) has studied the minimum seismic gap required between two neighbouring buildings to avoid the pounding phenomenon during earthquake using analytical method. He postulated that seismic gap calculated by using double difference combination (DDC) method was much more accurate than that of square root of sum of squares (SRSS) method.

3. CONCLUSION

Global responses of adjacent structures in terms of acceleration, velocity and displacement, amplify in case of pounding between them when they subjected to strong or ground motion than in no-pounding case. It is observed that force appearing on NSE in case of pounding is much higher than that of in no-pounding case. It is also observed that force appearing on NSE at 4th floor level is higher than that at 3rd floor level.

4. REFRENCES

[1] Anagnostopoulos, S. A., Spilliopoulos, K V (1992), "An Investigation of earthquake induced ponding between adjacent buildings", earthquake Engineering & Structural Dynamics. Vol.21, No.4, and Pp.289-302.

[2] C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan, R. Pradeep Kumar, Vipul V. Mehta, " Intoduction to earthquake Protection of Non-Structural Elements in Buildings", Gujarat State Disaster Management Authority, Government of Gujarat.

[3] Gregory L. Cole, Rajesh P. Dhakal and Fred M. Turner, "Building Pounding Damage Observed in the 2011 Christchurch earthquake", NZSEE Conference, 2010.

[4] IS 4326: 1993, "Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings", New Delhi.

[5] IS 1893(part I): 2002, "Indian Standard Criteria for Earthquake Resistant Design of Structures", part I General provisions and buildings, New Delhi.

[6] Youssefa M.A & Ghaffar zadehb H., Nehdi M., "Seismic performance of RC frames with concentric internal steel bracing" Department of Civil and Environmental Engineering, Shiraz University, Iran, 23 October 2006.

[7] Ferraioli M., Avossa, "Performance based assessment of R.C. buildings strengthened with steel braces", Proceedings of the 2nd International Congress Naples, Italy, 2006.

[8] T.EI Amoury, A. Ghobarah, "Retrofit of RC Frames using FRP Jacketing or steel bracing" , IJSEE: Vol. 7, No. 2, 2005.

[9] Rahai and m. Lashgari, "Seismic strengthening of nine-storey RC building using Concentric and buckling-restrained bracing", 31st Conference on our world in concrete and structures, 16 - 17 august, 2006.

[10] M.R. Maheri and H. Ghaffarzadeh, "Earthquake design basis for internally braced frame", The 14 Th World Conference on Earthquake Engineering, Beijing, China, October 12-17, 2008.

[11] Mahmood Hosseini, Peyman Shadman Heidari and Mojtaba Heravi, "Analytical and Experimental Study

of the Effect of Bracing Pattern In The Lateral Load Bearing Capacity Of Concentrically Braced Steel Frames", The 14th World Conference on Earthquake Engineering, Beijing, China, October 12-17, 2008.

[12] Arash Rezavani and A. S. Moghadam (2004), " Using Shaking Table to Study Different Methods of Reducing Effects of Building Pounding During Earthquake", 13th World Conference on earthquake Engineering , paper No. 698, Canada.

[13] Bipin Shreshta (2013), "Effects of Separation Distance and Nonlinearity on Pounding Response of Adjacent Structures", International Journal of Civil and Structural Engineering, Volume 3, No. 3.

[14] L. Di Sarnoa, A.S. Elnashaib, "Bracing systems for earthquake retrofitting of steel frames" Journal of Constructional Steel Research 65, 15 February 2009.

[15] Viswanath K.G., Prakash K.B. and Anant Desai, "Seismic analysis of steel braced RC frame" International Journal of Civil and Structural Engineering Volume 1, No 1, and 2010.

[16] Duggal S.K "Earthquake Resistant Design of Structures." Oxford University Press YMCA Library Building, Jai Singh Road, New Delhi, 2010.

[17] Bhunia S.A & Ramjiyani A.D , "Solution of shear wall location in multi-storey building" ,International Journal of civil and structural Engineering, Volume 2, No 2, 2011.

[18] Pankaj Agarwal, Manish Shrikhande, "Earthquake Resistant Design of Structures" PHI Learning Private Limited, 2011.