iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 Issue: IV Month of publication: April 2019

DOI: https://doi.org/10.22214/ijraset.2019.4563

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue IV, Apr 2019- Available at www.ijraset.com

Seismic Response Control of Adjacent Building Using Passive Device – A Review

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Abstract: In the past earthquakes, it's typically been determined that the separation distance between adjacent structures or adjacent elements of the structure is too little to accommodate their relative displacement, leading to collisions. The relative displacement is caused by the out of phase direction ensuing from their completely different dynamic characteristics, completely different foundation properties or the spatial variation of ground motion. Such collision leads to perennial hammer like blows on every structure. Some literatures on unstable impact on pounding and damages of adjacent structures have been reviewed from numerous journals and analysis papers. These studies contain analytical and experimental work. So that is why the literature's survey has been terribly helpful.
Keywords: Seismic Pounding, SDOF System, MDOF System, Adjacent Building Structure, Time History Analysis, Fluid Viscous Damper (FVD), Lump Mass System

I. INTRODUCTION

Pounding between adjacent buildings or between components of an equivalent building thanks to earthquakes has usually been recorded collectively or the causes of great or perhaps sever structural harm. This downside is especially common in several cities placed in seismically active regions/ wherever thanks to varied socioeconomic factors and land usage needs the codes allow contact between adjacent buildings. The pounding of adjacent structures throughout earthquakes has been receiving sizeable attention in recent years. This can be as a result of adjacent structures with inadequate clear spacing between them having suffered sizeable structural and nonfunctional harm as a result of their collision throughout major earthquakes. The different dynamic characteristics of adjacent buildings create them vibrate out of part and pounding happens if there is an absence of enough area between them. Pounding between adjacent structures could be a usually determined development throughout major earthquakes. Pounding might cause each field furthermore as structural damages and in some cases, it should results in collapse of the full structure. The interaction of adjacent buildings and also the collisions that occur between them throughout associate degree earthquake are repeatedly known as usual explanation for harm. This downside between structural system that are connected or in shut proximity to every different is often observed as structural pounding. Structural pounding refers to the lateral collisions between buildings throughout earthquakes. It happens when the adjacent buildings vibrate out of part and also at rest separation is low to accommodate their relative motions. The report when major earthquakes indicate that the structural interactions between adjacent, insufficiently separated buildings might end in substantial harm or perhaps results in the collapse of colliding structures.

II. OBJECTIVES

A. To compare the pounding response of two adjacent closely spaced elastic structures.
B. To evaluate and compare the elastic and inelastic pounding response of two adjoining structural system.
C. To investigate the pounding response of lumped SDOF and MDOF models with and without tuned mass passive damper.
D. To examine the pounding response of lumped MDOF models with and without fluid viscous damper.

III. LITERATURE REVIEW

Author N. V. Mate et al. (2017), the author had worked on seismic response of pounding of SDOF elastic and inelastic structures with the use of passive damper like tuned mass damper. The author had studied about two adjacent structures using tubed mass damper and found the results of with and without pounding. The study purpose by author was effective to reduce the seismic pounding response. The author had taken model of single storey building and provided tuned mass damper as gap element. The author showed in case of striking between two adjacent buildings. In that case another structure is elastic than alternative one and that elastic building structure experiences maximum deformation at the time of seismic excitation which was outcomes into additional pounding forces. The author had studied four earthquakes like Santa Monica-Northridge, Cope Mendocino, Loma Prieta and Superstition Hills. After that the author observed that right structure had less rigidity and left structure had more deformation.

Author Robert Jankowski and Sayed Mahmoud (2016) published paper on 3-storey building for mitigation of pounding at the time of earthquake in adjacent structure. The author had considered two adjacent 3-storey building structure with various dissimilar dynamic properties which were divided by gap size. The building was linked by spring elements, dashpot elements and viscoelastic elements and had different dynamic properties. Also calculated displacement time histories for building structures which is divided by the large gap size to prevent the pounding and found the displacement results for both the left and right building.

Author Robert Jankowski (2008) had performed response analysis of 3-storey building structure and in this response analysis, had studied about response in longitudinal direction, vertical direction and transverse direction. In parametric study, had studied about effects of gap size between building structure, effects of storey mass, effects of structural stiffness and the effects of yield strength. The parametric outcomes showed that gap sizes of 0.15 m are necessarily mandatory for avoid the striking of structure under the EI Centro ground motion. The whole study had focused on three dimension striking between adjacent 3-storey building structures. Also showed that, the outcomes of response investigation which is, structural pounding throughout earthquake had significantly influenced on behavior of lighter also maximum elastic building which is specifically in its longitudinal direction. The response analysis results indicate that behavior of substantial and rigid building in transverse, longitudinal and vertical direction stays nearly genuine by collision amongst structures. Author K. T. Chau et al (2003) in this paper, author had studied about the Hertz impact model against plastic flow model, maximum standoff distance, pounding response of 2 towers subjected to EI Centro Quake excitation. The experimental observation was compared with both numerical and analytical prediction of pounding model proposed by the author. A pounding frequency between two towers had developed an excitation frequency and developed other excitation cycle. Author Stavros A. Anagnostopoulos (1988) in this paper, the author had studied about pounding between adjacent structures due to earthquake which was noted as one of the substantial structural damage. The whole study was based on the pounding of building structure in series. The author had done parametric investigation to find the results of more general nature. The important parameters which were characterizing the problems are gap size of adjacent structure, system configuration and yield level of system, relative sizes of masses, impact element stiffness and damping. The motto of the study was to reduce the pounding in between the adjacent building structure or reduce the structural response and conclude that the pounding essential to be restricted by allowing sufficient gap amongst adjacent buildings.

Author M. Papadrakakis et al. (1996), the author had performed displacement time history analysis for EI Centro Earthquake and also studied strain energy envelope. After time history of response analysis, found the results for pounding and no pounding in X-X direction layout and Y-Y direction layout. In this study, it's evidently presented that the understanding of system response to parameter affecting the pounding occurrences which is also the characteristic of excitation, plan layout and dynamic characteristics of building structure. The author found that the strain energy is convinced to system throughout the striking phenomenon is reduced, comparing toward total summation of energies of single building once no pounding takes place.

Author S. Khatiwada et al. (2014), the author had discussed about pounding damages in bridge structure and buildings and also studied about linear or nonlinear force deformation connection. To perform the study of existing viscoelastic pounding models which had two types, linear viscoelastic model and modified linear viscoelastic model and similarly perform a study on acceleration time history and calculated all the pounding forces.

Author Shehata E. Abdel Raheem (2006) in this paper, had addressed the keywords are seismic pounding response, adjacent building structure, seismic design of structure, energy dissipation. The author had studied finite element modeling which had building modeling and impact modeling. Also studied about the required seismic separation gap distance to avoid, striking in between adjacent structures. In this study, had mentioned that the separation gap is important between adjacent building also had mentioned pounding effects and spacing size effects of adjacent building structure. By the study, to determine the degree of response of pounding system, the positive and negative displacements are necessary. Pounding response of building is decreased while pounding response is increased in flexible building.

IV. CONCLUSION

Many authors studied the effects of pounding for different type of structures such as single storey structure, multi-storey structures, regular structures, closed spaced structures and etc. After studying the complete analysis work done by all authors, it was observed that closely spaced structures, flexible structures and irregular structures creates a pounding between the storey with large amount of impact force. It was also observed that impact force creates the severe damages on the structures which lead to collapse of structural members. To control this, some authors proposed the control system and it was very effective in reducing pounding. Thus it concludes that controlling system is effective for seismic response control of all type of structures.

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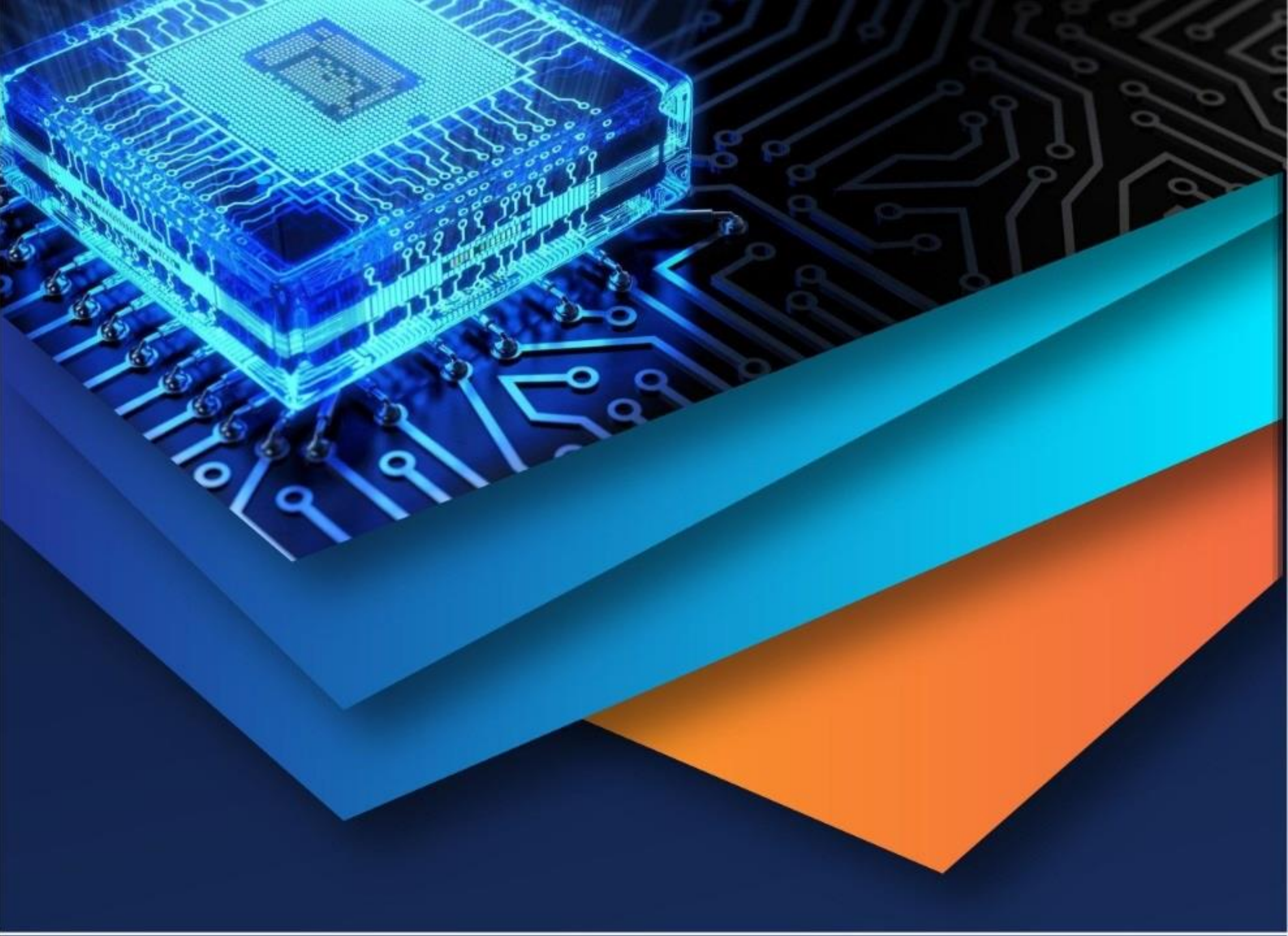

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