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Seismic Control of Structure using Fluid Viscous Damper...Review

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Abstract - *Earthquake creates great devastation in terms of life, money and failure of structure .examples from past earthquakes proves that conventional structure collapse or got damages during ground shaking. So, retrofitting of structure is necessary to protect human life ensuring that the structure will not collapse. The seismic protection using passive controlling devices now become more popular such as seismic dampers. From previous research observed that one of the most popular dampers is fluid viscous damper because its effectiveness in controlling interstory drifts, floor acceleration and other structural parameter. Its acts like shock absorber of motor vehicle dissipate more energy while strong ground motion. Numerous research is carried out for enhancing the effectiveness of seismic control system and there methodology. The aim of this paper is to review technologies for seismic control and introduced some literature review till now.*

Key Words: Earthquake mitigation, Seismic control system, Fluid viscous Dampers, Time History Analysis.

1. INTRODUCTION

Nowadays rapid growth in population an industries space demand getting increasing which leads to high rise building in cities ,Also we have to construct the buildings in seismic zones .hence its necessary to design our building structure seismic forces using some suitable techniques like seismic energy dissipating devices ,base isolation. seismic control techniques are accepted all over globe. it can be used as retrofitting purposes to provide flexibility to the structure. Dampers are available in wide varieties in the markets. One of the most popular dampers is fluid viscous damper because of enhancing performance and significant energy reduction. Another reason for getting popularity is the capability increasing damping of structure .it provides additional damping to structure without increasing forces in members. Various studied carried out using damper in SMRF frames, toggle bracing system. some research work focus on laboratory test using dampers.varous studies carried out using computer based programming software. Several studied focused on optimum placement of damper to reduce seismic performance and focused on cost as well .some researcher studied on selecting damper properties such as damping coefficient, velocity exponent, stiffness. Several researchers used different combination of damping coefficient for the studies.

2. Related Literature Reviews:

Soheila Kookalani et al(2020)A comparative Study carry out on the impact of various Fluid viscous damper parameters on the structures under the earthquake. In this a seven-story steel frame structure retrofitted with fluid viscous dampers was considered for analyzing with a variety of parameters. resulted that installing longitudinal nonlinear Fluid viscous damper can significantly reduce the seismic response by selecting reasonable damping parameters, including stiffness, damping coefficient, and velocity exponent. The optimum damping parameters has been calculated accurately by analyzing structure with different damping parameters of nonlinear Fluid viscous damper.

S. Lakshmi shreenbanu et al (2019)10 story building with or without damper created as per IS: 1893-2002 for study. Four modes were taken 1.square building square column 2.square building rectangular column 3.rectangular building square column 4.rectangular building rectangular column.tie history for bhuj earthquake has been defined in software ETABS 2016.all four building are modelled with or without damper and finally found that 75% reduction in base sher after time history also considerably reduction in roof displacement, story Drift etc.

Ahmad sepeheri et al(2018) In this paper seismic deign and assessment of structure using fvd at limit state level has studied. A procedure is carried out to mitigate devices damages during strong earthquakes .for study there were 15 special moment resisting frame with different number of stories considered the software use for this is OPENSEES for study limit state behaviour of fvd .

Ak.Sinha et al(2017) The study carried out taking two model one is of having 12 stories moment resisting frame without damper and another with damper Analysis was done sing ETABS Software. The selected type of damper is of nonlinear type. Nonlinear time history is carried out for analysis. The velocity exponent for damper is taken as 0.5 to limit damping force from past studies. Conclude that due to increase in seismic mass because of additional damper which leads to increase base shear value.

Abdelouahab Ras et al(2014) Analysis performed on 3D 12 story steel building ,numerical observation taken on it. Nonlinear FVD are installed diagonally inside the frame. a

comparative study done using two model using software SAP2000.one model is without braced and second one with braced FVD.A fast nonlinear time history performed for analysis. Modelling of FVD was carried out using mathematical expression for different values of velocity exponent. It was found that decrease in amplitude value increases the value of damping ratio for value of alpha less than one. Finally concluded that diagonals do not transmit any undesired axial forces but reduces damping compared to unbraced model.

Giuseppe et al (2014) A study carried out on the behavior of the moment resisting steel frame to seismic forces using viscous dampers. Iterative procedure is adopt to select the suitable dampers to protect structure against seismic data records . The comparative study between three different types of steel frames 3storey, 4 storey of 3bays and 12 storey of 5 bay with two types of dampers (hysteretic and viscous) installed in the middle bay which is subjected to 7 ground motions records was carried out to evaluate dynamic analysis to improve performance of the structure. The results shows that by using dampers the collapse mechanism of medium and high rise building was improved compared to bare frame, but for low rise case, this condition not satisfied.

H.kit Miyamoto et al,(2013) Studied using four story commercial building. For 3D mathematical models SAP Software is used. Nonlinear fvd is used to control stories drift .Nonlinear time history performed to determine performance. Two levels of seismic hazards investigated first (MCE) and second one (DBE).finally the maximum response quantities such as displacement, acceleration, and story shear evaluated.

Ying Zhou et al,(2012) In this paper Retrofitting of 7 stories building carried out in two stages having damaged infill walls and Cracked column beam joints. A parametric study is done for finding damping exponential value and damping coefficient. After on study its confirm that damping capacity of damper increases for both the values of damping coefficient 'c' and exponential value alpha. In this study stiffness of braces are taken 3 times greater than damper stiffness. In second stage, structure was tested against Drift values, Deformation values. Finally suggested that method adopted in this paper are suitable for major, moderate, minor Earthquake.

A. Munir et al, (2011) Deals with inelastic seismic demand of high rise buildings. For that they did an investigation on 40 storey residential high rise core wall building and compared it with its modal with suitable control measures. ETABS of version 9.0is used for creating model of the case study building as a linear elastic form and analyzed .A nonlinear time history analysis (NLTHA) was performed for maximum earthquake by applying 7 time history records. Another model created in PERFORM 3D software version 4 For NLTHA. Later 24 nonlinear FVD were placed in X direction as a control measures to reduce seismic demand of structure and damping force. Reduction in values of base shear, moment demand at foundation level and middle level of building was observed by 27%, 12% & 26% respectively. Inelastic behavior of high rise buildings with shear walls explained well in this paper.

Xue-Wei Chen et al (2010) studied the seismic response of the 4 storey Wenchuan hospital located in china using viscous damper. The aim of the design of study was to reduce the response of the structure. For that, hospital building with and without installed viscous dampers in the concrete frame structure was carried out under various levels of seismic vibrations. ETABS software is used to carry out static pushover and nonlinear time history analysis. Displacement at top, Storey drift, and damage of the structure got controlled by adding viscous damping. Internal force values increased due to addition of K-braced damping systems raised the stiffness of the structure. But in plastic condition of structure, it gets reduced along with deformation.

Yukihiro Tokuda1 and Kenzo Taga et al(2008) Recently viscous-type, seismic energy dissipation type devices have been well developed and have come into wide use in Japan, resulting in increase in use of such devices as oil dampers for high-rise buildings and for seismically isolated buildings. In this study the viscous type devices have been employed by focusing on the fact that viscous type device is superior to hysteresis type device in that viscous type devices display damping effect even under minor or moderate earthquakes. In that the viscous type devices display stable performance for assemble deformation. It is expected that energy absorption devices such as oil dampers are effectively incorporated to improve the earthquake resistance will be used more widely in the future. This paper introduces a practical case of "intensive vibration control structure on the first story" as a "technique to dissipate the energy efficiently and securely".

JinkooKIM,Chang-YongLEE et al(2003) If energy dissipating devices, such as base isolators, viscous or visco-elastic dampers, are added to a structure, it turns to so called a non proportional or a non classical damping system, and cannot be analyzed by the efficient mode superposition method based on real valued Eigen values and mode shape vectors. Although direct integration method provides exact solution for the non proportional damping system, the time and memory space required for the analysis prevent the method from being used for a practical application. In this research, a non-proportionally damped structure with added visco-elastic dampers are analyzed for earthquake excitations by the complex mode superposition method, and the results are compared with those obtained from the approximate methods such as the direct integration method with matrix condensation, modal strain energy method, and the method neglecting the off-diagonal terms of the

transformed damping matrix. According to the results, the complex mode superposition, with the advantage of using only a few dominant modes turn out to be very efficient procedure of analyzing the non proportionally damped structure added with viscoelastic dampers. The direct integration method combined with the matrix condensation technique also provides seismic responses with a reasonable accuracy. It is also found that the discrepancy between the exact solutions and the results from the approximate methods increases as the damping contributed by the addition of viscoelastic dampers increases, and as the dampers is non-uniformly placed.

D.Lee et al (2001) A detailed summary given on working method of FVD, installation method, and its future scope. In this paper effect of linear and non linear damper and their relationship studied. Various software like SAP and ETABS for modelling of dampers were suggested for seismic response reduction purposes. Also describe various bracing method of installing dampers.

M.D.Symans and M.C.Constantinou et al (1998) Focussed on FVD. In this study behaviour of FVD are examined by steady state cyclic test .Analytical study carried out to using damper to evaluate seismic response of scale-model building. Generalise different SDOF model to study linear and nonlinear behaviour of FVD. Finally a comparative study on values of stiffness damping coefficient obtain analytically and experimentally done. At the end concluded that FVD are effective in response reduction in story shear forces, story Drifts in the structure.

3. CONCLUSION

The Seismic Control of Structure using FVD Reviewed by Briefly Summarization. The review clearly indicates the capability of FVD and their importance in modern buildings. It plays important role to minimize the seismic response of the structures, also plays an important role by reducing inter-storey drifts, overturning moments, base shear, axial forces etc. with desirable cost control. Compare to other types of dampers, FVD has more life Efficiency which is almost near to design life of building structure which totally reduced the maintenance cost for dampers. 3. Different configuration for FVD [chevron, toggle, base plate, K-type Diagonal Bracing] provides ease of installation in any desired shapes and position of the bare frame models with effective functioning. It's also observed that for the seismic response reduction of high rise building, nonlinear FVD with $\alpha < 1$ is effective as compare to linear damper $\alpha = 1$.

REFERENCES

[1] Kookalani, S., & Shen, D. (2020). Effect of Fluid Viscous Damper parameters on the seismic performance. Journal of civil Engineering and Materials Application, 4(3), 141-153.DOI: 10.22034/jcema.2020.232288.1025

[2] Sepehri, A., Taghikhany, T., & Ahmadi Namin, S. M. R. (2019). Seismic design and assessment of structures with viscous dampers at limit state levels: Focus on probability of damage in devices. The Structural Design of Tall and Special Buildings, 28(1), e1569.

DOI: 10.1002/tal.1569.

[3] Sinha, A. K., & Singh, S. (2017). Seismic protection of RC frames using friction dampers. International Journal of Civil Engineering and Technology, 8(2), 2017.

[4] Ras, A., & Boumechra, N. (2014). Study of nonlinear fluid viscous dampers behaviour in seismic steel structures design. Arabian Journal for Science and Engineering, 39(12), 8635-8648.

[5] Miyamoto, H. K.,& Gilani, A. S. (2013). Seismic Viscous Dampers: A Cost-Effective Solution With Enhanced Performance for Retrofit and New Construction. In Proceedings of the 13th World Conference on Seismic Isolation, Energy Dissipation and Active Vibration Control of Structures, Sendai, Japan, Sept (pp. 24-27).DOI: 10.13140/2.1.4510.4003

[6] Zhou, Y., Lu, X., Weng, D., & Zhang, R. (2012). A practical design method for reinforced concrete structures with viscous dampers. Engineering structures, 39, 187-198.

[7] Munir, A., & Warnitchai, P. (2013). Optimal reduction of inelastic seismic demands in high-rise reinforced concrete core wall buildings using energy-dissipating devices. The Structural Design of Tall and Special Buildings, 22(7), 543-568.

[8] Chen, X. W., Li, J. X., & Cheang, J. (2010). Seismic performance analysis of Wenchuan hospital structure with viscous dampers. The Structural Design of Tall and Special Buildings, 19(4), 397-419.

[9] Tokuda, Yukihiro, and Kenzo Taga. "A case of Strctural Design in which viscous dampers are used to enhance earthquake resisting performance of a Building."

[10] Kim, J., Choi, H., & Min, K. W. (2003). Performance-based design of added viscous dampers using capacity spectrum method. Journal of Earthquake Engineering, 7(01) 1-24.

DOI: 10.1080/13632460309350439.

[11] Lee, D., & Taylor, D. P. (2001). Viscous damper development and future trends. The Structural Design of Tall Buildings, 10(5), 311-320.

[12] Symans, M. D., & Constantinou, M. C. (1998). Passive fluid viscous damping systems for seismic energy dissipation. ISET Journal of Earthquake Technology, 35(4), 185-206.