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STUDY OF SEISMIC BEHAVIOUR OF BUILDING WITH VISCOUS DAMPING WALL

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Abstract: The Republic Day quake of 26th January 2001 in Gujarat plainly clarified the tremor weakness profile of our country. The deficiency of lives and building structure colossally affected society. The harm that a construction will support relies upon an exceptional blend of topographical and primary variables. The previous identify with nature of soil under the establishment, profundity to bedrock, groundwater table, land highlights, and so forth Underlying elements could incorporate a level of imprisonment of cement, thinness of the structure and its segments and nature of its plan and development. Customary seismic plan approach gives or consolidates adequate firmness, strength and inelastic twisting limit so it can withstand incited dormancy powers. This was with the assumption that during solid ground movement, at whatever point inactivity powers surpass their plan seismic tremor levels, the design will disseminate this overabundance energy through distortions at predefined areas dissipated over the primary system.

Keywords: - *Viscous Damping Wall, Seismic Behaviour, Modelling*

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I INTRODUCTION

The With the pattern toward taller, light-weight structures, regular foundational layouts are frequently inadmissible in gathering the advanced issues of underlying vibrations brought about by complex powerful conditions. Adding energy disseminating gadgets into the construction is one arrangement that has been drawn closer in an assortment of ways. In this paper, an inactive control framework dependent on gooey damping (VD) dividers is introduced. This innovation can be consolidated either into new development or as a feasible answer for the retro fitting of existing structures. The conduct and viability of VD dividers in controlling machine initiated vibrations in a structure model were researched by free vibration test.

Numerous strategies have been proposed for alleviating the unsafe impacts of solid seismic tremors. The regular methodology necessitates that the designs latently opposes seismic tremor through a blend of solidarity, deformability and energy assimilation. The degree of damping in these constructions is extremely low. During solid quakes, these construction will disfigure well past as far as possible and stay flawless because of their capacity to distort in elastically. The inelastic twisting appears as restricted plastic pivots which brings about expanded adaptability and energy dispersal. Consequently, a significant part of the tremor energy is consumed by the design through confined harm of the sidelong power opposing framework. A substitute way to deal with relieve the risky impacts of quakes depends on a thought of the dissemination of energy inside structure. During seismic occasion, the information energy is changed to the construction through both active just as through potential energy which should be either retained or disseminated. Here, there is an issue in regards to retention of information energy communicated by seismic occasion, for little tremor design may retain energy yet for solid quake a huge bit of energy will be consumed by the hysteric activity for example harm to the construction. Henceforth, a substitute way to deal with improving the seismic reaction of constructions includes the consideration of supplemental energy scattering frameworks in the design.

II LITERATURE REVIEW

A)Study on buildings with large damping using viscous damping wall

Fumiaki Arima, Mitsuo Miyazaki, Hisaya Tanaka & Yutaka Yamazaki (Proceedings of 9th World Conference on Earthquake Engineering August 2 to 9, 1998, Tokyo-Kyoto, Japan (Vol. 5)

This paper clarifies another quake safe strategy for building structures utilizing Viscous Damping Walls. The plan recipes assembled from number of tests utilizing high thick liquid material are introduced. Additionally the adequacy of Viscous Damping Walls were finished up with the assistance of 5 story downsized model and 4 story full test system. The reaction of reasonable construction was examined and checked utilizing inelastic time history dynamic examination and the outcomes gave great concurrence with the noticed outcomes. The great factors that influence the seismic obstruction limit of construction are strength, pliability and damping. Traditional quake safe plan deal with strength and malleability without considering the damping factor. For certain seismic excitation the strength and pliability cutoff points of underlying individuals may surpass and it is extremely hard to configuration building designs to oppose solid seismic excitation inside flexible reach. Likewise, it is absurd to expect to check or guarantee the high flexible conduct in reasonable plans. Characterization of damping structures is done as follows: 1. Thick Damping 2. Coulomb Friction Damping 3. Hysteretic Damping 4. Dissemination or radiation Damping Efficiency of V D Wall To check the proficiency of gooey damping divider a progression of effectiveness tests have been led by the creators. The energy assimilation limit of downsized V D Walls (W60cm xH50cm) with a hole of 0.1-1cm and of genuine size (W2.0m x H1.5m) were tried utilizing thick liquid material of 3000-97000 balance (at 30 degree Celcius) at various temperature conditions.

III MODELLING OF VISCOUS DAMPING WALL

I. **Non-linear link (NLLINK) as a viscous damping wall**

II. The seismic response of Dynamic isolation systems viscous damping wall can be modeled using an existing nonlinear elements in SAP2000 using non-linear response history analysis. For viscous damping wall modeling, ETABS has identical features to SAP2000.

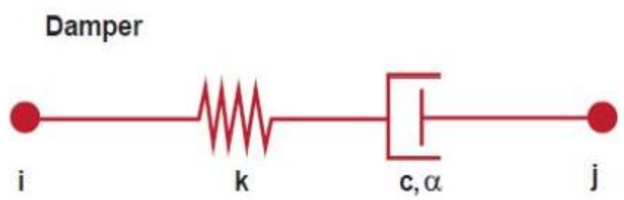

Figure 1: NLLINK as damping wall unit

Viscous damping walls are represented by an Exponential Maxwell Damper model, as shown in the figure 1 on above (from the CSI Analysis Reference Manual). The SAP2000 element type is Non Linear Link (NLLINK). The model consists of a linear spring K in series with an exponential damper given by C such that the force in the damper is related to the velocity across the damper through the force-velocity relationship F = C.Vα [7].Just like piston dampers, viscous damping walls are connected to the beams above and below in the plane of wall. Therefore to use the above 2-node element, a typical frame containing viscous damping walls can be modeled as follows:

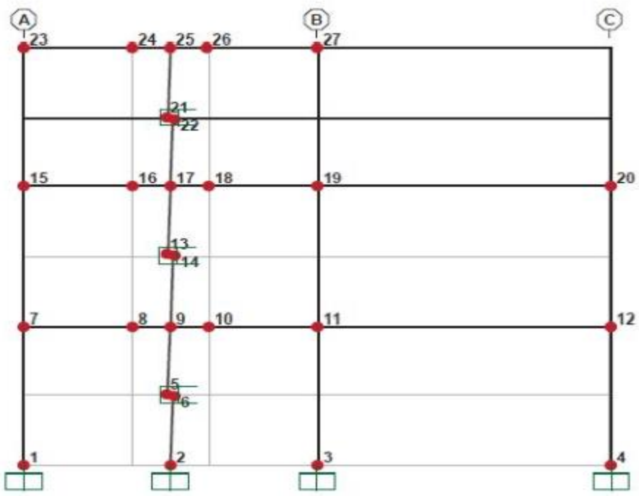

Figure 2: Modelling of viscous damping wall using NLLINK 1

Adding of viscous damping wall elements to an existing frame model.

The frame in this example is a two-bay, three story moment frame with 7-foot wide by 12-foot tall s centered in the bay between grid lines A and B. The story height is 15 feet and the bay width is 27 feet. The following modeling steps are required after typical modeling of the moment resisting frame members:

Step 1. In the damper bay(s), divide the beams into three elements such that the length of the center element(for example, between nodes 8 and 10) is the same as the width of the viscous damping wall, i.e. 7 feet in this case, and located to reflect the position of the viscous damping wall in the bay – centered in this example. Step 2. Divide the center elements into two equal elements (for example, creating nodes 25 and 17). Step 3. Since the viscous damping wall properties provided by Dynamic isolation systems include the stiffness of the tank and vanes and their effect on the beams above and below the VWD. Beam elements within the width of the viscous damping wall can be modeled as stiff. Assign Property Modifiers to the beam sections within the width of each VWD so that their moment of inertia, I33, is increased by a factor of (say) 100 relative to the actual beam section (see members with "PM" designation in figure 3 below).

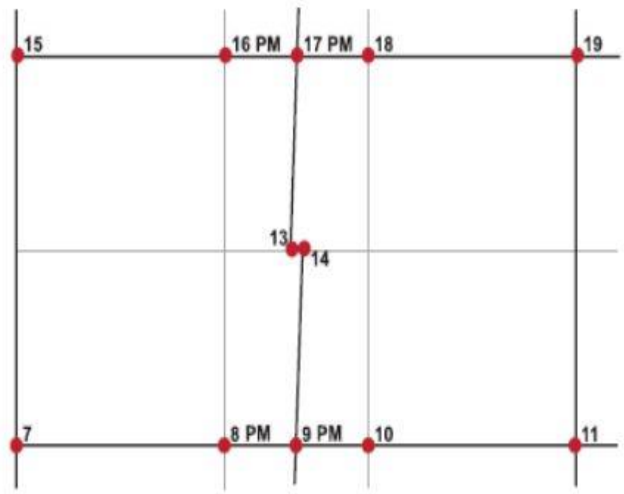

Figure 3: Modelling of viscous damping wall using NLLINK 2

Step 4. At the mid-height of each bay and story containing a viscous damping wall, create a pair of nodes (for example nodes 21 and 22) a small distance (for example 6-7 inches) apart. This pair of nodes should be centered within the width of the viscous damping wall.

Step 5. With a stiff frame element connect the center of the beam below to one of these nodes (in this case node 22), and the center of the beam above to the other (in this case node 21). The in-plane bending stiffness of these stiff elements should be comparable to that of the stiffened mid-section of the beam below (nodes 16-17-18) and the beam above (nodes 24-25-26), including the effect of the Property Modification factors, as discussed in step 3, above. The stiffness of these elements should be such that when the bay deforms in shear, including the forces generated in the VWD element (step 6), close to 100% of the total shear deformations concentrated in the damper element. This can be easily checked by comparing the in-plane drift between (say) nodes 15 and 23 with the deformation in the viscous damping wall element between (say) nodes 21 and 22.

Step 6. Connect the viscous damping wall NLLINK element horizontally between the two nodes at the mid-height of the storey and bay containing the viscous damping wall (for example, nodes 13 and 14). Use the “Draw 2 Joint Link” command from the SAP2000 draw menu. In a large model, viscous damping wall bay modeling can easily be duplicated by using the replicate features in SAP2000. Adding of NLLINK in SAP2000 is as shown in figure 4

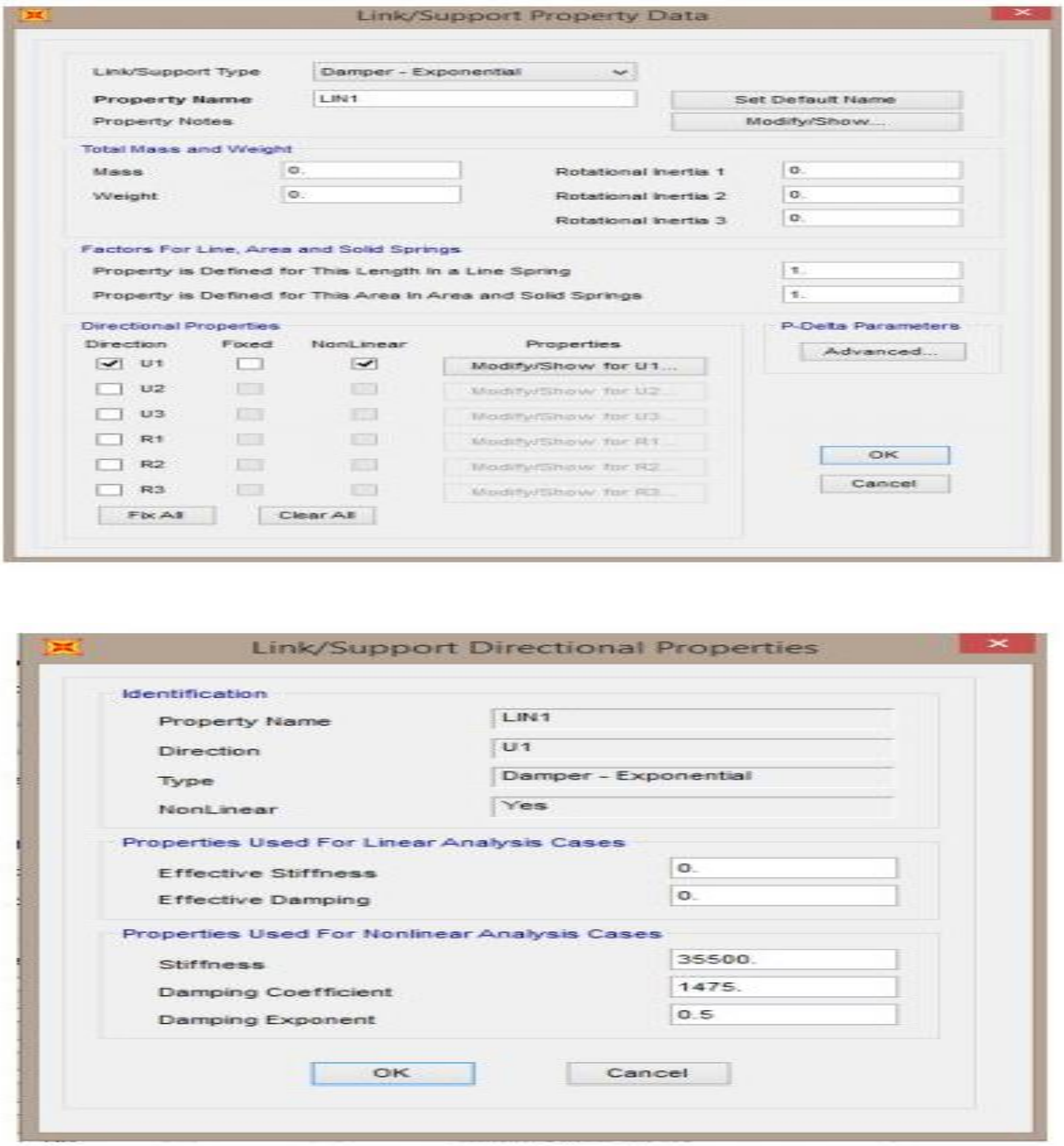

Figure 4: Adding of NLLINK and assigning properties to the link in SAP2000

The properties for different sections of viscous wall dampers are taken from the following table

			SINGLEVANE		DOUBLE VANE		(dimensionless)
DIS VDW	Width(m)	Height(m)	K [kN/m]	C [kN-(sec/m)$^{\alpha}$]	K [kN/m]	C [kN-(sec/m)	Damping exponent
1.8x2.1	1.8	2.1	23500	800	47000	1600	0.5
2.1x2.1	2.1	2.1	28500	1025	57000	2050	0.5
2.4x2.1	2.4	2.1	32000	1225	64000	2450	0.5
1.8x2.4	1.8	2.4	27500	975	55000	1950	0.5
2.1x2.4	2.1	2.4	32000	1225	64000	2450	0.5
2.4x2.4	2.4	2.4	35500	1475	71000	2950	0.5

Table no 1: various damping properties of damping wall according to their sizes

IV RESULTS AND DISCUSSION

Viscous damping walls are non-linear type of energy dissipaters which are more effective when damping exponent is 0.5. It has been found that the viscous damping walls can be successfully used to control vibration of the structure.

V CONCLUSION

Damping force generated in viscous damping walls are dependent on velocity of vane (inner plate). For viscous damping walls time history analysis is used. Considerable reduction in storey displacements, storey drift and base shear which are generally responsible for failure of building is observed. Viscous damping wall didn't prove to be effective for El Centro time history as compared to other applied time histories. Less number of viscous damping walls are found to be less effective in controlling the base shear and storey deflection of the building during seismic excitation. Experimental study shows that there is a considerable effect of added viscous fluid in the wall which successfully controlled the vibration of the structure. Acceleration of the top storey also reduced to the considerable extent.

VI REFERENCE

[1] Criteria for earthquake resistant design of structure. IS 1893 (Part I) : 2002.

[2] Passive fluid viscous damping systems for seismic energy dissipation, Symans M.D. and Constantinou M.C., ISET journal of earthquake technology, Paper No.382, Vol 35, No. 4, Dec 1998, pp. 185-206

[3] Decision analysis using virtual first run study of a viscous damping wall system Hung V. Nguyen, BarisLostuvaliand Iris D. Tommelein.

[4] Seismic Design of RC Structures Theory and practice by Manohar and Madhekar, Springer Publication.

[5] Dynamic Isolation Systems , Viscous Wall Damping, guidelines for modelling.

[6] Seismic Design of 15 storey Hospital Using Viscous Wall Dampers, James Newell, Jay Love, Mark Sinclair, Yu-Ning Chen, Amarnath Kasalanati, Structures Congress 2011

[7] Dynamics of Structures Theory & Applications to EQ Engineering, by Anil Chopra.