11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Seismic Evaluation of Braced Steel Structures with and without Viscous Dampers for near Fault Ground motions

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Key Words: *viscous damper, near fault, steel braced*

Near fault ground motions because of their large pulse impose large demands on structures compared to far fault ground motions. Also near fault excitation may cause a highly non-uniform distribution story ductility demand [1]. On the other hand strengthening buildings with increasing strength that could be accompany with increasing stiffness results to increase demand. By using supplemental damping devices it could be possible to mitigate the response of structure without increasing stiffness. In this investigation three prototype diagonal-braced steel structures with 4, 10 and 15 stories is evaluated against near field ground motions with and without viscous dampers by nonlinear time history analysis under immediate occupancy (IO) and Life safety (LS) limit states. The arrangement of dampers in the height of structures and their properties are considered in this investigation. The numerical model is validated by experimental model [2].The results compare the curve of force-velocity of viscous damper experimental model with numerical model under harmonic force that shows the results in numerical model depend on the stiffness of viscous damper severely (Fig.1)

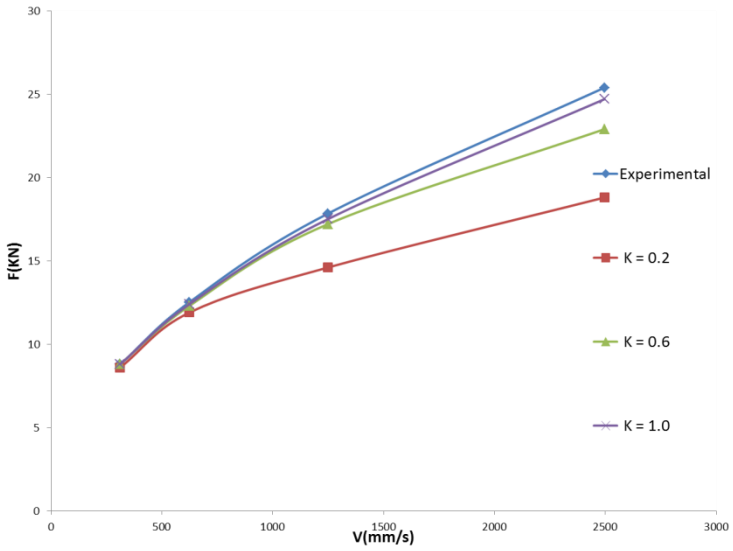

Figure1.Comparison of experimental and numerical viscous damper[2]

Also the results of 3 stories moment frame experimental model with viscous damper on the shaking table show the good agreement with numerical model with taking into account of stiffness of dampers (Fig.2&Tab.1).

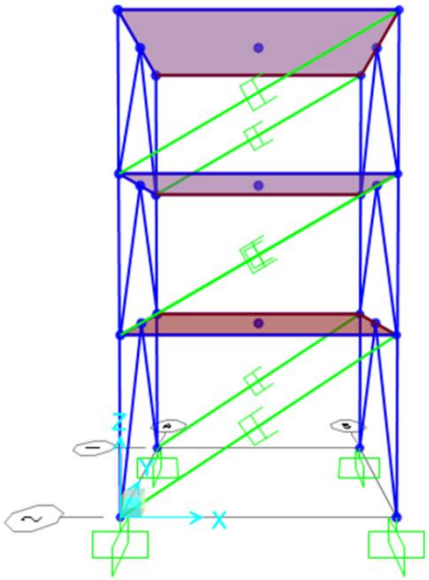

Figure2.The numerical model of 3 stories frame with viscous damper under El Centro earthquake [2]

Table1.Comparison of results of 3 stories moment frame (MF) with nonlinear viscous damper (NVD) [2]

Comparison of Results :		***Displacement (mm)***			***Story Drift (%)***			***Accelaration (g)***		
Frame ↓	Story →	1	2	3 Roof	1	2	3 Roof	1	2	3 Roof
MF	***Experimental***	***15.4***	***30.8***	***40.7***	***0.77***	***0.89***	***0.58***	***0.38***	***0.44***	***0.72***
	Numerical	***16.3***	***31.2***	***40.5***	***0.81***	***0.85***	***0.53***	***0.38***	***0.48***	***0.69***
NVD	***Experimental***	***4.6***	***8.9***	***11.3***	***0.23***	***0.25***	***0.15***	***0.12***	***0.14***	***0.15***
	Numerical	***4.3***	***8.3***	***10.6***	***0.22***	***0.25***	***0.15***	***0.11***	***0.15***	***0.17***
NVD/MF	***Experimental***	***0.3***	***0.29***	***0.28***	***0.3***	***0.28***	***0.26***	***0.31***	***0.32***	***0.2***
	Numerical	***0.27***	***0.27***	***0.26***	***0.27***	***0.29***	***0.28***	***0.29***	***0.31***	***0.24***

In the prototype structures a simplified method is used for specifying the properties of dampers. The response such as drift ratio, shear stories, acceleration stories and hysteretic behaviour of frames are compared in structures with and without dampers. In this paper the fragility curves based on PGA are obtained for comparing of seismic vulnerability of braced steel structures under near fault excitation with and without viscous damper.

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