Numerical analysis of vertical pipe damper

Ahad Javanmardi, Zainah Ibrahim, Khaled Ghaedi, Hamed Khatibi

Civil Engineering Department, Faculty of Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia

Hamed Khatibi

Department of civil Engineering, Faculty of Architecture and Built Environment, Limkokwing University of Creative Technology, Cyberjaya, 63000, Malaysia

Contact: ahadjavanmardi@gmail.com

Abstract

This paper proposes a new metallic energy dissipative device to mitigate structural damages under seismic excitations. In general, metallic dampers dissipate seismic energy through yielding. The inelastic cyclic deformation of the proposed damper, dissipates the seismic energy through yielding of the steel material. Herein, a three-dimensional finite element model of the damper is developed considering material nonlinearity, large displacement and contact. To aid the aim, the damper performance is studied through cyclic quasi-static tests. The parametric study is performed to find which parameters have higher influence on its performance. The results show that, the damper is exhibited excellent strength and ductility, stable hysteresis force-displacement behaviour with notable energy-absorbing capability to dissipate the seismic energy. Furthermore, it is found to have light weight, economical with ease of fabrication and implementation which used as a potential alternative for passive control of structures.

Keywords: passive energy dissipation; yielding damper; metallic damper; seismic control; hysterics curve; Vertical Pipe Damper

1 Introduction

It has proven that no prediction methods using different available techniques can forecast the earthquake events [1]. Thus, it is a necessity to protect civil structures in face of such disasters. In past decays, the use of passive energy devices have gained popularity in order to mitigate damage and failure to the structures [2,3]. Despite of active and semi-active energy systems, the passive energy systems enhance the seismic response of the structure without any external source of energy [4,5] as they are one of the most popular passive energy device. This is due to their advantages, i.e. reliable, economical, ease of fabrication, installation and maintenance. To this end, engineers have widely interested to use the application of such devices in structures. In this system, although, the efficiency of time varying devices (e.g. tuned mass damper, tuned column liquid damper, liquid damper, tuned liquid ball damper), friction dampers and viscous damper devices have been proven, but they are typically tuned to the individual dynamic excitations and their efficiency is bandwidth-limited [5]. On the contrary, the metallic dampers have attracted many attentions in vibration control of civil structures under dynamic loadings. Use of metallic devices in structures is get benefit of yielding characteristic of metals to harvest earthquake input energy. Nevertheless, one of the disadvantage of metallic dampers is generating

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