NUMERICAL EVALUATION OF MULTI LEVEL YIELDING RING DAMPER

Hossein TIZHOOSH
M.Sc. Student, Seraj Higher Education Institute, Tabriz, Iran
tizhoosh.hossein93@gmail.com
Elham MOADDAB
Assistant Professor, Seraj Higher Education Institute, Tabriz, Iran
e.moaddab@seraj.ac.ir
Gholamreza BAGHBAN GOLPASAND
Assistant Professor, Seraj Higher Education Institute, Tabriz, Iran
gholamreza.golpasand@gmail.com

Keywords: Hybrid, Ring damper, Moderate earthquake, Sever earthquake, Energy dissipation

In this paper, a new type of dual-performance passive dissipating devices called TRYD (three ring yielding damper) is introduced as alternatives to the available yielding ring dampers (Andalib et al., 2018). Modified types of the conventional ring dampers are detailed and designed to absorb and dissipate seismic input energy at different levels of ground motion intensities. Proposed system is composed of a main fuse to dissipate energy at high-level drift demands occurred in severe earthquakes and an auxiliary fuse to control the responses at lower drift demands normally occurred in moderate earthquakes. The hybrid damper is basically a displacement-dependent device which dissipates seismic energy by yielding of outer and inner rings. The yielding of outer ring occurs at small displacement, which makes it effective in resisting small earthquakes. The inner rings (main fuse) remain elastic during small earthquakes and are activated at major earthquakes.

Eight finite element model with different thickness and diameters of inner and outer pipe (as detailed in Table 1) have been modelled and analysed under cyclic loading by ANSYS software. Schematic view of modelled damper is shown in Figure 1. Loading protocol was selected based on SAC loading protocol (SAC, 1997) and force-displacement curve for all models have been extracted. Figure 2 illustrate the force-displacement characteristics for model 1. As seen in this figure two level of force increasing have been occurred when gap displacement passed. The value of force is about 35 kN before reaching that gap displacement while in displacement beyond the gap distances and in final displacement, 165 kN achieved.

Table 1. Properties of numerical model.

SAMPLE	$D_e(mm)$	$D_i(mm)$	$t_e(mm)$	$t_i(mm)$	D_e/D_i	D_e/te	Di/t_i
1	400	100	10	10	4	40	10
2	400	100	10	8	4	40	12.5
3	400	100	12	10	4	33.33	10
4	400	100	12	8	4	33.33	12.5
5	400	80	10	8	5	40	10
6	400	80	10	6	5	40	13.33
7	400	80	12	8	5	33.33	10
8	400	80	12	6	5	33.33	13.33
9	350	80	10	10	4.375	35	8
10	350	80	10	6	4.375	35	13.33
11	350	80	12	10	4.375	29.16	8
12	350	80	12	6	4.375	29.16	13.33

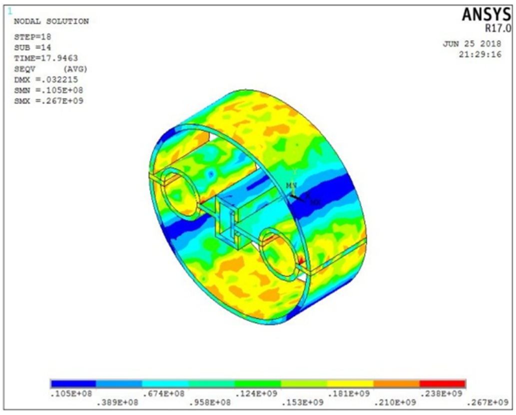

Figure 1. Von Mises stress counter of sample1.

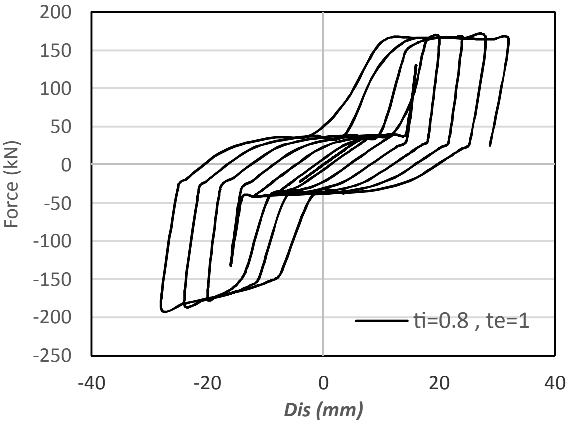

Figure 2. Obtained force displacement of sample1.

Obtained results indicated that altering the diameter and thicknesses of outer and inner rings affects the energy dissipation capacities in both fuses. Also the effect of diameter to thickness ratio have been evaluated on the energy dissipation capacity in eight models. This Results demonstrated that increasing the (D/t) ratio lead to decrease the energy dissipation capacity.

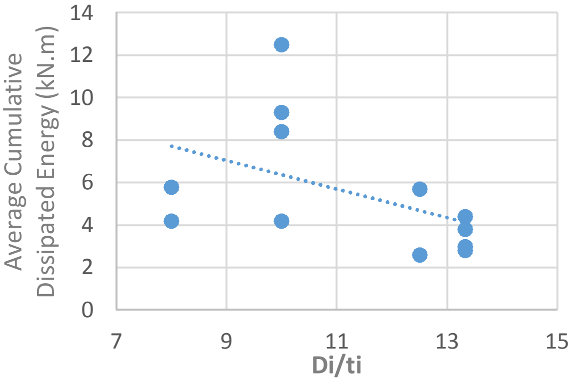

Figure 3. Effect of (D/t) on average cumulative dissipated energy of all models.

REFERENCES

Andalib, Z., Kafi, M.A., Bazzaz, M., and Momenzadeh, S. (2018). Numerical evaluation of ductility and energy absorption of steel rings constructed from plates. *Engineering Structures*, 169, 94-106.

Clark, P.W., Frank, K., Krawinkler, H., and Shaw, R. (2002). Protocol for Fabrication, Inspection, Testing and Documentation of Beam-colum Connection Tests and Other Experimental Specimens. *SAC Joint Venture*.