8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

ASSESSMENT OF STEEL CURVED DAMPERS IN IMPROVING SEISMIC PERFORMANCE OF STEEL FRAMES

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Keywords: Steel damper, Cyclic behavior, Energy dissipation, Seismic performance, Hysteresis curve

Using the inelastic deformation of steel is a useful method to dissipate the input energy of earthquake in structures. In order to achieve an economical seismic plan, absorption and energy dissipation capacity of structures should be considered. In recent years, different methods to increase the energy dissipation capacity of buildings have been proposed by a large number of researchers. Using steel dampers in structures is one of the effective methods for improving the seismic performance of buildings. The performance of steel dampers is based on yielding of the metals. When the internal forces of steel damper is greater than its capacity, the damper will be yielded and damages to the main members of structures will be prevented by absorbing the input forces (Saeedi et al., 2016). Due to the mentioned reasons, in seismic zones such as Iran, the performance evaluation of energy absorbing systems, such as steel dampers, needs to be further investigated.

The steel curved damper investigated in this study is one of yielding dampers proposed by Hsu & Halim. The steel curved damper is used in steel moment frames as a beam to column joint (Hsu & Halim, 2017) and it is also used in braced frames (Hsu &Halim, 2018). The steel curved damper, due to its simplicity in geometry and the speed of its construction and installation, can be used to improve the seismic performance of structures and seismic rehabilitation of existing buildings. These dampers are made by the laser-cut of steel plates with the desired geometries. In Figure 1, the details of steel curved damper are observed.

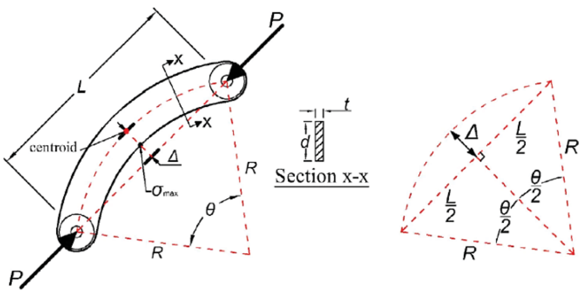

Figure 1. The details of steel curved damper geometry (Hsu & Halim, 2017).

In this study, the effect of geometric parameters on the behavior of steel curved damper was evaluated. In addition, the effect of steel curved damper on the improvement of seismic performance of steel frames has been investigated. For this purpose, the effect of some geometric parameters such as length, width, thickness and angle between two ends of the damper on the behavior of damper was assessed. These dampers are modeled using ABAQUS software and evaluated under cyclic loading protocol. The results showed that by decreasing the length of curved damper from 1500 mm to 700 mm and reducing the angle from 150 ° to 90 °, the energy dissipation and stiffness of the damper increased, as shown in Figure 2.

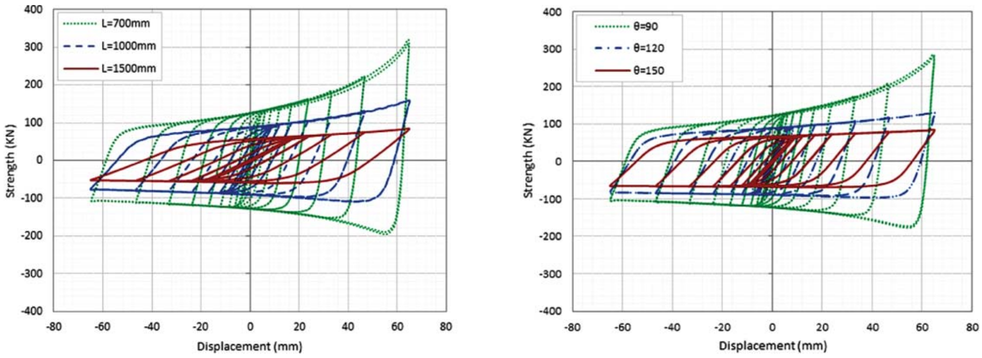

Figure 2. The effect of damper geometry on energy dissipation capacity.

In order to investigate the effect of curved dampers on improving the seismic performance of steel structures, a one-story steel moment frame was modeled in ABAQUS and it was equipped with and without steel curved damper. The results show that the addition of curved damper to the frame has had a significant effect on increasing the energy dissipation capacity and the stiffness of the steel frame. Improved seismic performance of the steel frame with curved damper is shown in Figure 3.

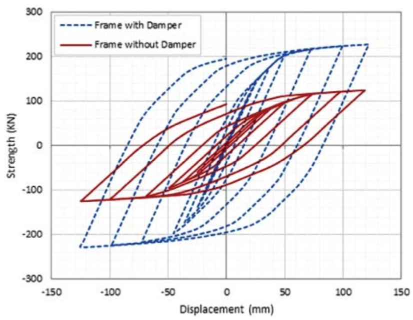

Figure 3. Comparison between the hysteresis curve of the steel frame with and without damper.

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