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SEISMIC PERFORMANCE ASSESSMENT OF STEEL STRUCTURES WITH STEEL CURVED DAMPERS

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The traditional concept of designing buildings for earthquake excitations is based on plastic behavior of the main elements of structure such as beams, columns, braces and thus energy absorption in the main members of structures can cause structural damages in the structural elements. In addition, after the first cycles of an earthquake excitations, most members of structure exhibit strength degradation and low damping. To avoid these deficiencies, the concept of structural control was proposed and developed by various researchers in recent decades (Mahjoubi et al., 2016). One of the methods for controlling the structure response is the use of passive control devices such as steel dampers. These devices improve the seismic performance of structures without any external source of energy by using the inelastic deformation property of steels. During a severe earthquake, a large amount of energy is imparted to a structure, possibly causing structural damage. Using energy dissipation devices installed within a structure, the input seismic energy can be dissipated by these devices. Using steel dampers as supplemental energy dissipating devices is one of the earliest approaches adopted in seismic resilient design. When the force of steel damper is more than its capacity, the damper is yielded and by absorbing the input forces, it prevents damages to the main members of structures (Tagawa et al., 2016).

The steel curved damper studied in this research is one of the passive control devices. These dampers are laser-cut of steel plates with the desired geometries. Curved dampers can be a useful device for improving the seismic performance of structures due to the lack of complexity in construction, performance and the speed of its installation. 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).

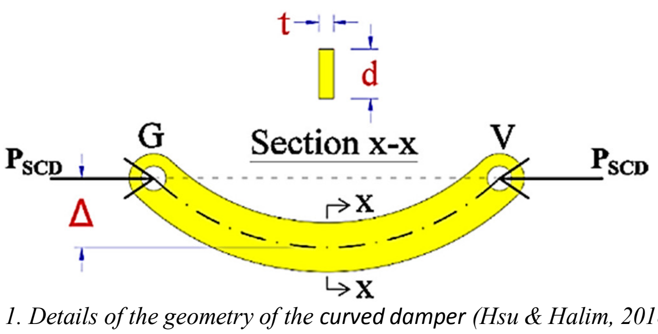

Figure 1. Details of the geometry of the curved damper (Hsu & Halim, 2018).

In this study, the seismic performance of steel structures with steel curved damper has been investigated. It should be noted that the effects of the steel curved dampers on the seismic response of multi-story structures have not been studied. For this purpose, a four-story steel frame was designed in ETABS software. Then, using OpenSEES framework, the structure was analyzed with and without steel curved damper under far-fault earthquake records. For this purpose, a steel curved damper with 700 mm length, 90 mm depth and 30 mm thickness according to Hsu and Halim (2018) study, was modeled in OpenSEES and the result of verification can be found in Figure 2. The story drift angle and displacement of the steel structure represents in Figure 3. The results show that using steel curved damper will decrease the seismic response of steel structures.

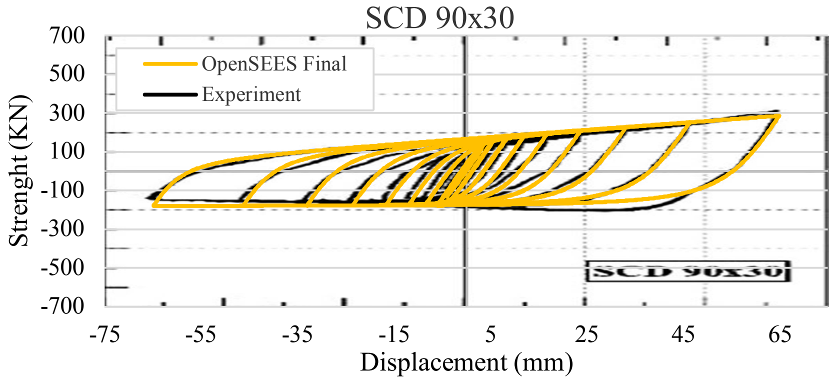

Figure 2. Modeling of steel curved damper in OpenSEES according to the experimental results of Hsu and Halim (2018) study.

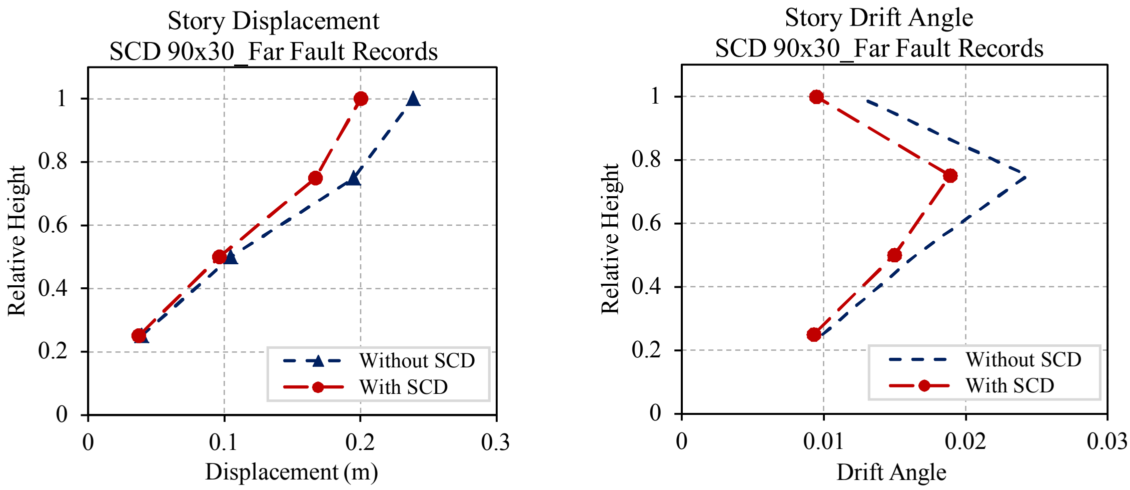

Figure 3. Comparison of story drift angle and displacement of 4-Story steel frame with and without steel curved damper.

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