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INTRODUCING ECCENTRICALLY BRACED FRAME SYSTEM EQUIPPED WITH DISTRIBUTOR FUSES WITH STEEL PLATE

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Eccentrically braced frame is reckoned as one of the lateral force resisting systems due to its desirable performance in shear as well as ductile behavior of its link beam. In this bracing system, it is intended that the dissipation of energy is achieved by concentrating the formation of plastic hinges in the link beam region. A number of investigations have been carried out by researchers so as to improve the seismic performance and increase in the capacity to form plastic hinges in the link beam zone. According to seismic design code, any type of external elements connected to the link beam or the reduction of the cross-sectional area in this region is not allowed since it will have adverse consequences on the performance of the bracing system. In addition, the observation of the eccentrically braced frame performance in some earthquakes reveals that undesirable buckling of the flange and web as well as the rupture at the edge of the link beam connection to the end stiffener have been occurred.

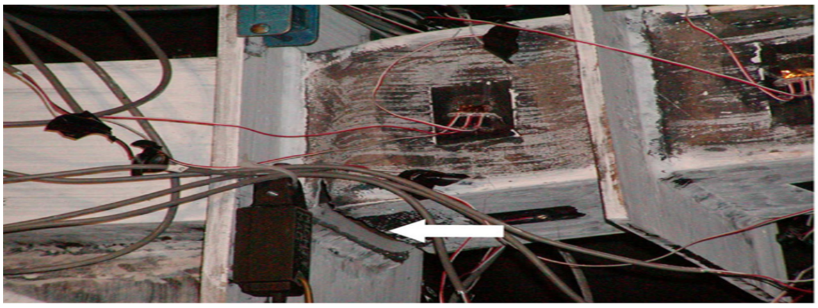

Figure 1. Failure in the area of connection between the link beams with end stiffener (Berman & Bruneau, 2007).

In the current study, with the aim of improving the seismic performance of the link beam in eccentrically braced frame considering some structural limitations in the irreplaceability of the bracing fuse as well as the reduction of the fracture in connecting zone of the link beam and also reducing the damage caused by the undesirable buckling of the web and flange of the link beam so as to increase the energy absorption capacity as well as increase in ductility and the shear capacity of the eccentrically braced system, a new model of eccentrically braced system equipped with distributor fuses with steel plate subjected to the hysteretic loading protocol in Abaqus software is evaluated. In this method, the plastic hinge formation as well as the dissipation of energy applied to the braced frame are conducted in two steps. At the beginning of hysteretic protocol loading, the steel plate in lower region of the distributor fuses enter into its nonlinear behaviour. In the next step with increasing in the loading hysteretic as well as the stresses applied to the brace frame, the distributor fuses ultimately enter into nonlinear behavior. The obtained results of the cyclic performance of the analyzed model demonstrate that the new EBF bracing model has a higher shear strength as well as desirable ductility capacity compared to the original one.

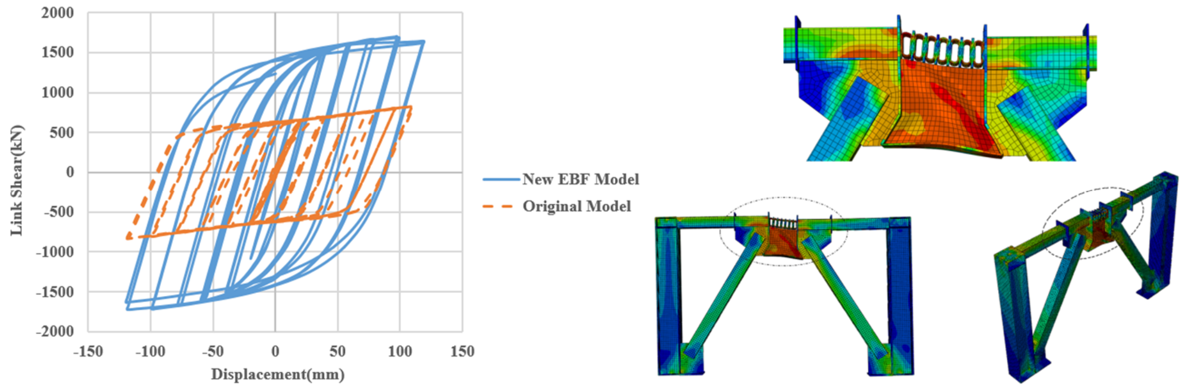

Figure 2. A new model of the eccentrically braced frame system equipped with distributor fuses with steel plate with the plastic behavior along with the effect of fuse coupling stiffeners in preventing rupture and the comparison of the cyclic performance of the new EBF model compared to the original one.

Table 1. Comparison of shear performance and the amount of ductility and hysteretic behavior of new EBF Model compared to the original EBF one.

Models	Max Link Shear Force (kN)	Displacement (mm)	Energy Dissipation (kJ)	Stable Hysteretic Behavior
Original Model	835	117.04	2036.17	ok
New EBF Model	1718.32	118.9	4172.06	ok

Finally, the dissipation energy rate in the new eccentrically braced model compared to the original one shows a dramatic increase. In addition, the obtained results reveal the existence of the stiffener of the coupling of the distributor fuses, leads to the uniform stress distribution in the fuses, and, prevent failure at the edge of the connection between the beam and the link beam. Furthermore, the obtained results of the analysis show that making use of steel plate in the lower region of the link beam with the consideration of the seismic design requirements, due to the uniform yield of the steel plate with increasing in the flexural yield capacity brings about positive effect on improving the cyclic performance of the eccentrically braced frame. Finally, considering the overall yielding of the steel plate in the lower region of the distributed fuses as well as subsequent uniform bending yield in the fuses, cause an increases in the ductility capacity in the bracing frame and ultimately leads to a significant increases in the energy absorption rate compared to the original EBF model. Moreover considering the overall yielding of the steel plate and flexural yielding over the entire length of the link (fuses) and minimizing stress concentrations, this approach can be a good suggestion for irreplaceable link beams with high reliability compared to the original EBF model due to undesirable buckling in the web and flange of the link beam.

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