Experimental Seismic Fragility of Steel Studded Gypsum Partition Walls and Fire Sprinkler Piping Subsystems

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Partition wall and fire extinguishing nonstructural sprinkler piping subsystems constitute a significant portion of the total investment in building infrastructure. Past earthquakes and numerical simulations have demonstrated that damage to these nonstructural subsystems can cause substantial earthquake losses and degrade the overall functionality of buildings. Nevertheless, the data obtained from field observations, previous experimentations, and numerical simulations are insufficient to fully characterize their mechanical response under seismic actions and to develop effective solutions to improve their seismic performance. As part of the NEES Nonstructural Grand Challenge Project: Simulation of the Seismic Performance of Nonstructural Systems, the University at Buffalo Nonstructural Component Simulator (UB-NCS) is being used to evaluate the seismic performance of full-scale light gage steel studded gypsum partition wall and fire extinguishing sprinkler piping subsystems. Fifty partition wall specimens, corresponding to 22 different wall configurations, were constructed following standard construction techniques typically used in commercial and institutional facilities in the United States. Quasi-static and dynamic tests were carried out to assess the in-plane and out-of-plane seismic performance of the gypsum walls. Thirty six piping joints, corresponding to nine common joint configurations, materials and diameters have been tested and will be followed by dynamic sprinkler subsystem testing including interaction with ceiling tiles. The experimental results are being used to characterize the mechanical behavior of piping joints and sprinkler heads and to develop a seismic fragility database for nonstructural systems.