Sign and signal structures involved in vehicular accidents are often partially damaged, and the ability to repair them is possible instead of replacing them, even when the extents and severity of the damage are substantial. The replacement of these poles is costly and involves interruption for pedestrian and traffic. Therefore, some trials were performed to retrofit these poles in situ with low cost and short time. Previous research has substantiated that the damage can decrease the capacity of the these structures with increasing the dent depth and the use of externally bonded fiber-reinforced polymer (FRP) composites are beneficial to repair them. The composite systems were comprised of glass or basalt fibers paired with epoxy or polyurethane matrices. The effectiveness of FRP in repairing the damaged poles was demonstrated in previous tests on dented poles using 3-point, 4-point, and cantilever bending tests. The repair systems were able to develop the load carrying capacity of the damaged poles, and their behaviors were controlled by various types of failure modes like yielding of the metallic substrate, FRP tensile rupture, FRP compressive buckling, and debonding of FRP from the substrate.

This thesis investigates the resistance of repaired full-scale metallic poles retrieved from the field for monotonic, cyclic, and impact loading. These poles which have rounded and multi-sided cross sections with and without access ports were dented in the field or dented mechanically in the laboratory and repaired with the same repair systems mentioned previously. Six of these poles were mounted horizontally in a cantilever configuration to test them monotonically while three of them were tested cyclically. In both tests, the load was applied as a point load at 9 ft from the base plate. Moreover, two poles were mounted vertically using a cantilever configuration to test them for impact. This test was performed by hitting the poles using an impact pendulum with a 1100 kg mass.

The results of static tests show that the repair systems failed because of the aforementioned failure modes. However, most of the failure was located outside the dented region, which indicates the effectiveness of these repair systems in restoring the capacity of the damaged area. During the fatigue tests, the repair experienced no damage before weld rupture in the original steel tube-base plate connection. Moreover, the repair systems proved their effectiveness in resisting the impact load, because they were ruptured at the contact region between the pole and the impactor at the time the poles were deformed at the free side of the poles in addition to the impact side during the test. In all these tests, the access ports were affecting the behavior of the repaired poles. Depending on the geometry of the pole, metal substrate, and dent depth and location, FRP repair system recommendations will be presented.