Executive Summary

Based upon a combination of in-situ field monitoring of traffic-induced bridge vibrations at the location of the failed sign support truss, finite element simulation of the expected dynamic response of the original truss in such an environment, the length of service of the truss at the time of its failure, the volume of truck traffic on the bridge in question during that time of service, and metallurgical examination of the failed components of the sign truss, the conclusion of the investigation is that extremely high-cycle fatigue of the chord/web diagonal welded connection was the cause of the truss failure. The in-service effective stress range of the AASHTO Category ET connection in question was most likely below the currently specified AASHTO constant amplitude fatigue limit (CAFL) for the detail, but the enormous quantity of response cycles (approaching or even exceeding 1 billion cycles) such a bridge mounted sign on a heavily traveled route accumulates over a service lifetime of 30 or 40 years, exceeds anything currently considered in the design codes for such structures. The implications of this fact on the current inventory of such structures in similar installations and of the same age range, i.e., installed with the original interstate routes, largely in the 1960's, are obvious.

The one somewhat puzzling aspect of the lower chord fracture of this structure, namely that the fracture passed near the weld toe but not actually contacting the weld toe, does not appear to be particularly significant. The fracture did indeed pass close to the weld and certainly within the heat affected zone of the weld. The fracture surfaces were too abraded to positively identify the initiation point; small cracks, however, were also identified within the weld under microscopic examination. The original flaw which eventually propagated and produced the rupture, apparently in this case, just happened to be near the weld rather than in the weld.