

ABSTRACT

Godbole, Amol A. Ph.D., Purdue University, August 2012. Evaluation of Fatigue on the Serviceability of Highway Bridges. Major Professor: Dr. Mark D. Bowman.

Laboratory and analytical studies were performed to develop improved methods to evaluate and assess the serviceability of bridge structures for the limit state of fatigue as a part of a research effort to revise and update Section 7, "Fatigue Evaluation of Steel Bridges" of the Manual for Bridge Evaluation for consideration by AASHTO.

Cyclic laboratory tests of bolted lap splice connections with various types of tack welds were conducted to evaluate the influence of the tack welds on the fatigue strength of the mechanically fastened connection. Finite element analysis was also performed to investigate the stress flow through the tack weld specimen and predict the most probable location of fatigue crack initiation in the specimen. From the experimental results, it was found that the fatigue strength of tack welds can be adequately modeled using a Category C design life as given per the LRFD Bridge Design Specification.

Full-scale subcomponent laboratory tests were performed to evaluate distortion induced fatigue cracking and to examine the fatigue performance and behavior of various stiffening retrofit options. Recommendations were provided based on the observed

fatigue behavior of the retrofits. In addition to the experimental testing, finite element analyses were also performed to predict critical stress locations of retrofits for the test specimens and practical bridge span examples.

Work was also carried out on improving a new index called the “Fatigue Serviceability Index” to assess the fatigue limit state. This index involves a quantitative assessment to evaluate the condition rather than the remaining fatigue life. Other factors examined include the current use of S-N Curve and the values of resistance factor R_R used in Section 7.