# ABSTRACT

Chotickai, Piya Ph.D., Purdue University, August, 2004. Fatigue Reliability-Based Analysis Methods for the Evaluation of Steel Bridge Structures. Major Professor: Mark D. Bowman.

The objective of this research study is three-fold: to evaluate the accuracy of current available fatigue load models for estimating the fatigue damage accumulation, to investigate alternative procedures in determining bridge responses under truck traffic loadings, and to develop a convenient fatigue evaluation procedure for steel bridge structures.

Truck traffic data collected from three different weigh-in-motion (WIM) sites were simulated and used as input loadings for various analytical bridge models. Fatigue damage accumulations were computed based on Miner's hypothesis and compared with the damage predicted by current available fatigue truck models. It has been found that these fatigue trucks do not provide an accurate estimate of the damage over a wide range of bridge spans. Accordingly, new 3-axle and 4-axle fatigue trucks were developed. These new fatigue trucks have been shown to more accurately estimate the fatigue damage over a wide range of span lengths.

The potential of using traffic count data to estimate the gross weight of a fatigue truck was investigated from an analysis of the vehicle database. The developed statistics for use of traffic count data were compiled with the fatigue reliability concept to predict the fatigue life of two steel bridge structures. The use of traffic count data has been shown to predict cyclic lives relatively close to that predicted using WIM data and a 54-kip gross weight of the AASHTO fatigue truck. Therefore, it may be employed as another alternative in the evaluation. Additionally, strain gage data collected at the two structures were decomposed by two cycle counting procedures, one with and one without the racetrack method. The counting results reveal that effective stress ranges produced by the

two procedures are not significantly different. This indicates that the racetrack method may be a useful tool to facilitate the counting procedure and significantly reduce the computational time required to predict the fatigue life.

Based upon the results obtained from the analysis of a given vehicle database and a parametric study of the fatigue limit state function, an evaluation procedure for the fatigue reliability-based analysis of steel bridge structures was developed. The procedure can be utilized to provide a remaining fatigue life with a prescribed confidence level.