CHAPTER 9
SUMMARY AND CONCLUSIONS

9.1 Summary

The evaluation of the field data collected by VTRC provided insight on the composite action, load distribution, and dynamic load allowance associated with the steel girders of the Little Buffalo Creek Bridge. The evaluation of the bottom panel, deck stress ranges provided insight on the fatigue behavior of different detail categories within the deck, and allowed for a minor evaluation of a typical mechanical deck splice.

The low top flange strains measured during the load tests indicated that the steel girders and aluminum deck were acting composite. The percent composite evaluation assumed pure bending of the steel girders, which may not have been the actual behavior of the steel girders. The neutral axis locations from the field data were calculated using an assumed elastic, linear strain distribution throughout the depth of the girder. It is proposed that the top flange strain measurements from the pseudo-static, one-lane loaded tests were influenced by torsion of the top flange, which was not considered in the percent composite evaluation. Using the linear strain distribution, the torsional strains altered the location of the neutral axis, and thus made it difficult to draw accurate conclusions on the composite behavior of the steel girders and aluminum deck.

The load distribution behavior amongst the girders was found to vary significantly depending on the transverse location of the trucks on the bridge surface. The load distribution was found to be independent of truck speed and longitudinal location for periods when the truck was entirely on the bridge. The bridge was assumed to behave similar to a concrete deck in System II bending. Neglecting multiple presence, the distribution factor comparisons showed that the design calculations and AASHTO SSHB (1996) distribution factors were larger than the distribution factors determined from the available field data for typical and non-typical, transverse truck locations. The AASHTO LRFD (1994) distribution factors were not always larger than the distribution factors determined from field data.
The available field data did not allow for many solid conclusions to be drawn concerning the dynamic load allowance for the girders of the Little Buffalo Creek Bridge. The dynamic load allowances determined from the test data covered large ranges, and dynamic amplification was not always achieved. One distinct trend resulting from the dynamic load allowance evaluation was that dynamic load allowances determined from deflection data were greater than or equal to similar values determined from WIM bottom flange strain data. No explanation exists as to why this occurred. The large ranges of dynamic load allowances within similar tests performed with near identical trucks at nearly identical speeds did not allow for conclusions to be drawn concerning the effects of speed on the dynamic load allowance. Other parameters, such as initial vehicle vibration and initial bridge vibration, were not monitored and could have affected the dynamic load allowance evaluation. The large ranges tend to solidify past researchers’ conclusions that the dynamic load allowance is affected by many parameters and thus is a non-deterministic value that can only be obtained using statistical procedures involving data collected from normal traffic.

The deck stress evaluation showed that all of the stress ranges from the monitored locations were well below the detail categories’ allowable fatigue stress ranges for three typical numbers of cycles. In addition, the stress ranges from the field data were well below the detail categories’ fatigue limits for constant-amplitude loading from the SAS-ASD (1994), and even below the AASHTO LRFD (1994) stress ranges for finite life. The limited field data did not allow for an exact conclusion on whether or not the deck was adequately designed for fatigue considerations. The mechanical deck splice evaluation involved low stress ranges (σ < 1.25 ksi), thus no gross discontinuities were observed as a result of the test truck loads.

9.2 Need for Further Research

As mentioned in each chapter discussing the results, there is a definite need for further laboratory and in-service testing. The ALUMADECK bridge system is a
relatively new concept and any structural testing completed on the actual bridge or components there of would be beneficial to future applications.

The composite action evaluation exemplified the difficulty in trying to evaluate component behavior from a complete system. The grouted deck-to-girder connection should be laboratory tested to prevent the effects of torsion and to allow for a complete evaluation of the connection at a full range of loads. Controlled, component testing would allow for different parameters, such as deck width and number of shear connectors provided, to be altered to determine the effects on the composite behavior of the deck and girder.

Further testing to evaluate the load distribution amongst the girders of the Little Buffalo Creek Bridge could be performed to provide more accurate representations for use in evaluating and rating the bridge. Based on the efforts of past researchers, future testing could involve both normal traffic and/or additional load tests with test trucks. Altering the transverse location of test trucks may provide a means of determining a worst case distribution for each particular girder, which may or may not be less than the distribution factors typically used in bridge ratings.

As mentioned in the previous section, accurate conclusions concerning dynamic load allowance for the girders of the Little Buffalo Creek Bridge were unable to be drawn from the field data provided by VTRC. Future tests to determine the dynamic load allowance for the girders of the Little Buffalo Creek Bridge should involve both calibration tests with test trucks and normal traffic. The testing and instrumentation method suggested by Bakht and Pinjarkar (1989) seems to be a logical method for determining the dynamic load allowance for an existing bridge.

There is a definite need for future laboratory and in-service testing concerning the topic of fatigue of the aluminum deck details. Laboratory fatigue testing should involve full-scale deck panels with configurations similar to that possible in the field. Laboratory fatigue testing would allow for removal of the wearing surface. This would allow for more detailed gauging patterns to monitor strains on the top and bottom of the deck panel. Additional in-service testing should involve a procedure similar to that taken by
Stallings et al (1996), where stress ranges and cycles are determined from a load spectrum involving normal traffic. The data collected from normal traffic would provide a more accurate representation of the maximums, minimums, and effective stress ranges that different locations of the deck undergo. Future evaluation of the mechanical deck splice could involve laboratory fatigue testing and/or strength tests to determine the effectiveness of the splice in transferring loads laterally and longitudinally.