AN ABSTRACT OF A DISSERTATION

DEVELOPMENT OF SKEW CORRECTION FACTORS FOR LIVE LOAD SHEAR AND REACTION DISTRIBUTION IN HIGHWAY BRIDGE DESIGN

Qinghe Zhang

Doctor of Philosophy in Engineering

Live Load Distribution Factors have been used in bridge design for many decades as a relatively simple method to estimate live load effects on bridge members for the design and evaluation of bridges. Skew correction factors (SCF) are applied to the live load distribution factors for the corresponding non-skewed bridges to account for the effect of skew in skewed bridges. The distribution factor and SCF equations specified in the current AASHTO LRFD Specifications include limited ranges of applicability, and when these limitations are not met the specifications mandate a refined analysis. In NCHRP Project 12-62, the SCF were kept fundamentally the same as the current LRFD. Therefore, the range of applicability for the SCF introduces an inconsistency between the almost unlimited newly developed distribution factor equations and the skew correction equations. Currently, no simplified methods can predict live load distribution factors for the bridges with structural parameters exceeding the range of applicability. In addition, the skew effect on reactions at piers of skewed continuous bridges are determined either by using the SCF for shear or by using no SCF, even though a difference between SCF for reaction and shear were found in skewed bridges.

The research described herein is intended to develop SCF equations for shear and reaction distributions without limitations on their range of applicability. In order to develop new equations, an automated analysis program with APDL (ANSYS Parametric Design Language) in ANSYS, a commercial finite element method code, was created so that the maximum responses for various types of bridges under live loads could be obtained. The analyzed bridges, developed with the α-θ method, covered all the possible ranges of applicability for the structural parameters in current practice. Distribution factors for reaction forces were compared to those for shear to verify the necessity to develop the specific skew correction factors for reactions. A parametric study on the effect of span length, girder spacing, and skew angle was conducted for various types of bridges. Two sets of simplified equations were developed for SCFs for both shear and reaction distributions for the LRFD types a, k, b, d and f. One set was based on the AASHTO LRFD Specifications and the other was based on NCHRP project 12-62. The slightly-greater-than unity average, low standard deviation, and coefficient of variation for each proposed SCF equation indicate high reliabilities of these proposed equations in predicting the SCFs for shear and reaction distributions for various types of bridges without limitations on the range of applicability.