ABSTRACT

Chovichien, Voraniti. Ph.D., Purdue University, August, 2004. The Behavior and Design of Piles for Integral Abutment Bridges. Major Professor: Robert J. Frosch.

Integral abutment bridges have been used in the United States for decades. By eliminating expensive expansion joints, the piles supporting the end bent accommodate the total thermal movement of the bridge. Currently, integral bridges are designed based upon experience, and a rational design specification has not been developed. Furthermore, the interaction of the abutment, pile, and soil remains uncertain. A better understanding regarding the behavior of this system is needed. The objective of this research is to evaluate the behavior of the integral abutment-pile system and evaluate any limitations of its use. To achieve this objective, two phases of research were conducted. The first phase was a field study that investigated the in-service pile behavior of four integral abutment bridges. The second phase was an experimental study that was used to evaluate the capability of piles typically used in integral abutment bridges. Nine low-cycle, large amplitude lateral displacement pile tests were conducted. Throughout both phases, analytical investigations were also conducted. To develop simplified modeling techniques that sufficiently account for soil-pile interaction, the piles supporting abutments were analytically modeled and calibrated based on the field and experimental results. A parametric study was also performed with variables including pile type, pile orientation, axial load, pile length, and soil type. The results of these phases were evaluated and design recommendations were developed based on these results. Overall, the design recommendations provide for an extension in the length limits often used for integral bridges. The extension of these limits can result in a reduction in bridge construction and maintenance costs for a large number of structures that cannot currently be built using this structural system.