TECHNICAL SUMMARY
Assessment of Mitigating Embankment Settlement with Pile-Supported Approach Slabs

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INTRODUCTION

Problems involving highway bridge approach settlement have been observed at many sites in Louisiana. Differential settlement caused by the large settlement of the approach embankment and the relatively fixed pile-supported abutment causes the bumps at bridge ends.

In south Louisiana, where subsoil settlement potential is the greatest, the bridge structures are usually lengthened to reduce the height of the approach embankment. On major structures, pile-supported approach slabs have been used to mitigate the settlement and soften the approach bumps.

The research has identified which factors have contributed to total approach settlement in pile-supported approach slabs in south Louisiana. New design guidelines have been developed.

OBJECTIVES

i. Identify an adequate number of pile supported approach slab sites in South Louisiana and collect designs, soil conditions, construction records, traffic data and existing rideability conditions.

ii. Evaluate the overall performance of the existing pile supported approach slab systems.

iii. Perform field tests at representative pile-supported approach slab sites.

iv. Perform a parametric study on the pile supported approach slab system using the information compiled.

v. Develop a simplified soil/structure interaction method to examine the effects of various parameters on the performance of a pile supported approach slab.

vi. Perform a cost/benefit analysis of the pile supported approach slab system.

RESEARCH APPROACH

The researchers have identified and located about 90 bridge sites with pile-supported approach slabs across southern Louisiana. The collected information, such as approach slab dimension, approach slab reinforcement, pile spacing, pile length, embankment dimensions, embankment material, soil conditions, etc., was compiled into a database named LAPS.

Seven representative sites were selected for thorough in-situ investigations and sampling. Field work performed by Tulane, Department of Transportation and Development, and Louisiana Transportation Research Center personnel at the representative sites included visual inspection of the pavement, bridge, approach slabs and ramps, settlement measurements, slab crack measurements, assessment of drainage conditions, etc. Field instruments used included a walking profiler, Dynatest, laser profiler geodetic total station, soil borings and cone penetrometer.

A simplified soil/structure interaction method was employed to examine the effects of various parameters on the performance of pile-supported approach slabs. A detailed analysis was performed to examine the effects of the various parameters identified in the selection of representative testing sites, field testing of representative testing sites, and the laboratory testing of soil samples. A design procedure was developed to determine the most effective pile supported bridge approach system design.

DISCUSSION OF RESULTS

This research has identified and located about ninety bridges with pile supported approach slabs across south Louisiana. Using the information compiled in the database, analyses were made to determine the possible causes for approach slab settlement. Bar graphs and pie charts were used to compare various parameters of concern for both pile-supported and

non-pile supported approach slabs selected for this study. Ratings from the current condition records as well as the newly developed rating system using the IRI were used to compare performance of the different approach slabs.

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CONCLUSIONS

A rating system based on IRI values obtained from the laser profiler indicate that four percent of the slabs were in very good shape, 22 percent in good shape, 33 percent in fair shape, 22 percent in poor shape, and 19 percent in very poor shape. This method was preferred over the current rating system used by the New Orleans District office because it is accurate, consistent, and more subjective. These results show that the standard design being used by DOTD does not always produce acceptable field performance.

A Microsoft Exel spreadsheet computer program with Visual Basic Application (VBA) macros has been developed for use by DOTD design engineers for parametric studies of pile supported approach slabs. The software allows input of various site conditions and accounts for downdrag in the selection of pile lengths. The proposed methodology provides a pile-supported approach slab with an estimated settlement based on anticipated drag loads and specific site characteristics. This program input consists of pile characteristics and will accept the input from other computer programs directly involving pile load capacity and soil and embankment settlement profile.

The collected information of 104 identified sites: approach slab dimension, approach slab reinforcement, pile spacing, pile length, embankment dimensions, embankment material, soil conditions, etc. was compiled into a database, LAPS, for future use by DOTD, if so desired.