Research Project

97-4GT

C a p s u l e

Technology Transfer Program

LTRC

April 1997

Assessment of Mitigating Embankment Settlement with Pile-Supported Approach Slabs

Starting date: 3/1/97

Duration: 24 months

Completion date: 2/28/99

Funding: State

Principal Investigator:
Sankar C. Das, Ph.D.
Tulane University

Co-Principal Investigators:
Reda M. Bakeer, Ph.D.

LTRC Contacts:
Administrative:
Harold "Skip" Paul
Assoc. Director, Research
(504)767-9102

Technical:
Mark Morvant
Research Manager
(504)767-9124

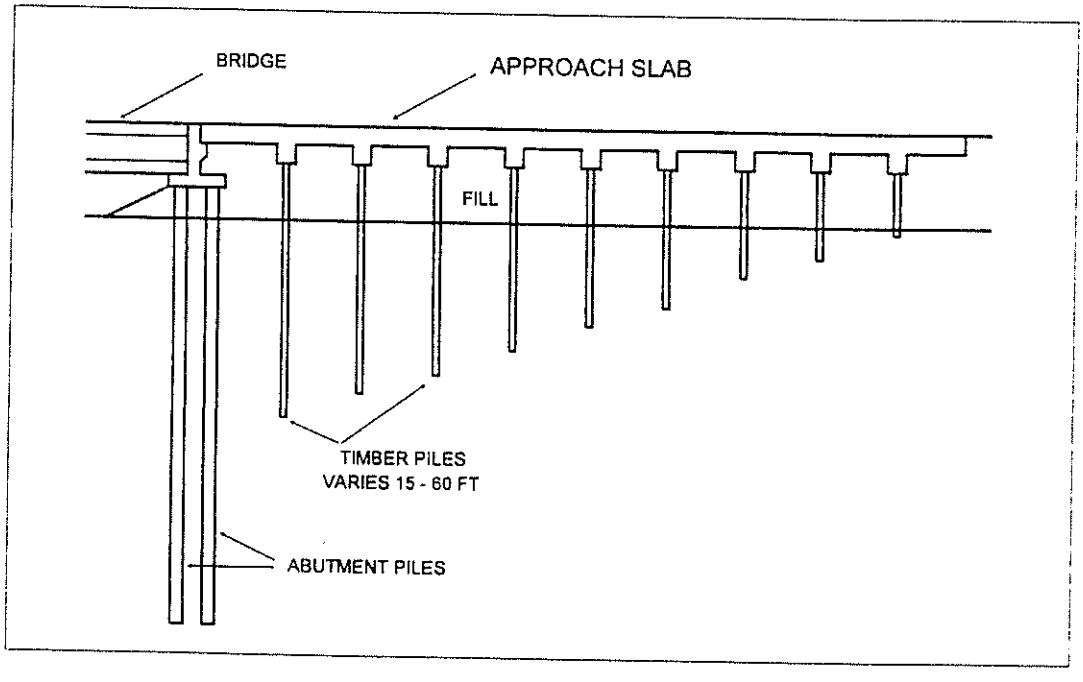
Problem

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.

The formation of pavement soft spots and bumps on this part of the bridge structure affect rideability, cause greater impact loads to the superstructure from the abutment, and contribute to drainage and erosion problems underneath the approach and adjacent to the abutment and wingwalls.

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

Over the years, many pile supported approaches have performed well, while others have settled enough to create bumps at the bridge ends. In many other areas of the state, DOTD has implement-



LTRC

Louisiana Transportation Research Center

Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

4101 Gourrier Avenue
Baton Rouge, LA 70808-4443

ed accelerated settlement techniques, such as preloading in association with wick drains, with some promising results. Certain project sites and loading conditions may prove this method to be more cost effective than pile-supported approach slabs.

The proposed research will identify the factors which have contributed to total approach settlement in pile-supported approach slabs in south Louisiana. New design guidelines may be developed.

Objectives

- To identify an adequate number of pile-supported approach slab sites in south Louisiana and collect designs, soil conditions, construction records, and traffic data
- To define and collect field data to evaluate the performance of the approach slabs
- To perform a parametric study of the approach slab embankment system
- To perform a cost benefit analysis of the pile-supported approach slab as compared to other soil improvement techniques
- To develop an effective design procedure.

Working with LTRC and DOTD, this research will also identify a subset of slabs where in-situ soil testing will be performed by LTRC. Soil samples from the sites will be obtained and tested by Tulane.

Description

The researchers will identify and locate sites of bridges with pile-supported approach slabs across southern Louisiana. Representative sites will be selected (about 15) for thorough in-situ investigations and sampling, the results of which will be compiled in a database of the sites to be developed by Tulane.

A literature search will be performed to obtain further information on the use of other ground improvement techniques utilized in similar soils. This may include a survey of other states' experience and project histories on this issue. A cost/benefit analysis will be performed comparing the pile-supported approach slab system to other ground improvement or accelerated settlement techniques.

Field work to be done by Tulane at the representative sites will include visual inspection of pavement, bridge, approach slabs and ramps, settlement measurements, slab crack measurements, assessment of drainage conditions, etc. Detailed information of all the identified sites will be compiled in the database.

Relevant published materials will be culled for information pertinent to the database.

A simplified analysis of beams/plates on equivalent elastic foundation and other simple soil/structure interaction methods will be used to examine the effects of various parameters on the performance of a pile-supported approach slabs.

A more extensive parametric study of the pile-supported approach slab system will be conducted using the nonlinear finite element method.

A design procedure will be developed to determine the most effective bridge embankment approach system. The design should address embankment heights and maximum allowed settlements to achieve an acceptable level of rideability. The procedure will address length and thickness of the approach slab, length and spacing of the piles (if applicable), and/or technique used to mitigate long term settlement.

Implementation Potential

The intent of this research is to yield a simplified design procedure that can be used to verify the effectiveness of an appropriate bridge embankment approach system. The design will address embankment heights and maximum allowed settlement to achieve an acceptable level of rideability.

This procedure will likely benefit DOTD designers by providing them with a tool for the systematic evaluation of the most cost-effective approach slab embankment system.