LTRC Technical Summary Report 396

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Louisiana Transportation Research Center

4101 Gourrier Ave., Baton Rouge, LA 70808

Development of Laboratory Testing Facility for Evaluation of Base-Soil Behavior Under Repeated Loading: Phase-1: Feasibility Study

Introduction

Accelerated pavement testing (APT) facilities were developed to simulate years of traffic loading in a compressed period of time and to allow for the collection of reliable pavement performance data in a much faster, more effective, more economical manner. The application of well-controlled traffic at these facilities, along with laboratory test data, helps to develop mechanistic methods to design pavements, validate design assumptions, validate new construction technologies and materials, and evaluate the conditions of existing pavements.

Currently, various test facilities used throughout the United States to evaluate and/or predict pavement behavior can be categorized into three major types: ***1) large scale (wheel-beam) facilities, 2) model (reduced scale) facilities,*** **and** ***3) cyclic plate load (load-actuator) facilities***. The selection of the type and specifications of the facility involves careful consideration of the inherent advantages and limitations of each facility. The technical and operational aspects of each of the facilities were reviewed, as were the setup costs, maintenance requirements, and operational capacities (number of sections tested in a year). A cost-efficiency study should then consider the initial cost, maintenance costs, and test section preparation cost.

The ***large scale facilities*** usually exceed 30 feet in length and are capable of simulating heavy truck loads. The ***model mobile load simulators (MMLS3)*** are much smaller devices with reduced wheel sizes and axle loads. Due to their small axle loads and tire sizes, they require either a resizing of the pavement layers (a reduction in the thicknesses of the constituting layers) or the testing of each of the pavement layers independently. ***Cyclic load actuators***, on the other hand, are programmable and well controlled devices that can apply numerous load-time functions at different frequencies and amplitudes. Despite the differences between the wheel and the cyclic plate, the cyclic plate load actuator is a common and reliable facility**.**

Objective

The main objective of this study was to determine the most beneficial and cost-effective accelerated load facility that can be used in conjunction with LTRC's Accelerated Load Facility (ALF). The facility will be used primarily for conducting preliminary and comparative experimental studies that will have results and findings that can be implemented and used in developing the experimental program of the LTRC's full scale ALF.

Scope

This study was based on the results of a comprehensive review of available accelerated load testing facilities and communication with researchers who have experience with the facilities. Site visits, in addition to demonstrations of the equipment and operation of different facilities, were major factors contributing to the contents of this report. What resulted was a comparison of the advantages and disadvantages of the different types of facilities.

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Research Approach

To accomplish the objectives of the study, the research methodology included the following major tasks:

- Comprehensive literature survey to explore other experiences regarding large scale and full scale testing; published works relevant to design and behavior of flexible pavements under cyclic loading
- Personal communication with different research and academic agencies, as well as researchers with expertise with accelerated testing of pavements sections
- Field visits to observe the operation and preparation of selected test facilities, including demonstrative workshops and ongoing major projects
- Preparation of final report on recommendations of the appropriate test facilities that can be deployed for future testing of flexible pavements, based on a comparative study of the different testing facility options considering the reliability and resemblance to actual field conditions and loadings as well as cost-effectiveness

Conclusions

Based on this feasibility study, the following conclusions were made concerning the advantages, shortcomings, and benefits of each of the three facilities:

- The vehicle simulator and the cyclic load actuator can be conveniently used to conduct comparative performance studies of different designs, construction materials, or new technologies pertaining to highway and pavement engineering.
- The cyclic load actuator is the most effective and beneficial device. This device can be used in conjunction with the LTRC-ALF to enrich the database of accelerated load test results.
- The cyclic load actuator device is a powerful tool for conducting preliminary and comparative studies, due to its inherent advantages of speed, test duration, and the possibility of applying various load-time functions to resemble different traffic loading scenarios. This device may also be used for other research studies such as resilient modulus testing under actual confinement conditions.
- The MMLS3 device cannot be used for accelerated load testing of full pavement structures. The two approaches used to relate the results of the MMLS3 to the full scale pavements are based on questionable assumptions and are not yet validated.
- The benefit cost analysis indicated that the cyclic load actuator is more cost-effective than the vehicle simulator. The difference in costs between the two facilities increases with the number of test sections.

Recommendations

Considering the designated objectives of the proposed facility, along with the advantages, drawbacks and limitations; specifications and capabilities; and the benefit-cost ratios of each device, the cyclic load actuator is recommended for consideration as the most appropriate device at this time. This device can be further improved to enhance its predictability and reliability in future research studies.