LOUISIANA TRANSPORTATION RESEARCH CENTER
LTRC

RESEARCH
PROJECT CAPSULE

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[12-7P]

TECHNOLOGY TRANSFER PROGRAM

Roller Compacted Concrete over Soil Cement under Accelerated Loading

JUST THE FACTS:

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24 months

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

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

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PROBLEM

Roller compacted concrete (RCC) is a stiff, zero-slump concrete mixture placed with modified asphalt paving equipment and compacted by vibratory rollers. Properly designed RCC mixes can achieve outstanding compressive strengths similar to those of conventional concrete despite low cement content. On the other hand, the cost per square yard of RCC is only about 60 percent of the cost for conventional Portland cement concrete pavement. RCC has traditionally been used for pavements carrying heavy loads in low-speed areas due to its relatively coarse surface. With improved paving and compaction methods as well as surface texturing techniques, recent applications of RCC have been found for interstate highway shoulders, city streets, and other highways.

RCC is an economical and durable candidate for many pavement applications. Its proven durability combined with a simple and cost-effective construction method has created a great deal of interest from many state and local transportation agencies. The Louisiana Department of Transportation and Development (LADOTD) has great interest in finding out if a thin RCC layer (usually 4 ~ 6 in.) can be suitably used as a cost-effective alternative design to its current practice of asphalt surfacing for both low- and high-volume road applications in Louisiana.

OBJECTIVE

The overall objective of this research study is to evaluate the structural performance and load carrying capacity of RCC surfaced pavement structures through accelerated pavement testing, and document the experience of mix design and construction practice of RCC pavements for LADOTD.

METHODOLOGY

To achieve the objective, the following sequential tasks have been defined:

Task 1: Literature review
A comprehensive literature review will be conducted on RCC pavements and materials related to the mix design, construction practice, performance evaluation, and structural thickness design. Special attention will be paid to the evaluation of RCC in roadway applications.

Task 2: RCC mix design
The RCC mix used in this study will be designed at LTRC's concrete research lab. All structural design material input parameters (e.g., flexural strength, fatigue life, and durability) will be determined.

Task 3: Construction of test sections
Six RCC pavement test sections (each of 71.7 ft. long and 13 ft. wide) will be constructed. As shown in Figure 1, the construction will require removal and re-construction of two existing test lanes (Exist. 4-2 and 4-3) at the pavement research facility (PRF) site. The proposed test sections include three RCC thicknesses (4 in., 6 in., and 8 in.) and two base types: an 8.5-in. cement stabilized base and a 12-in. in-place cement treated base. Generally speaking, sections 1-3 are designed to determine if a thin RCC surface layer can be used as a cost-effective alternative in lieu of asphalt concrete surfacing for low-volume roads having significantly heavy

truck traffic; whereas, sections 4-6 are designed to study the RCC surfacing for high-volume road applications.

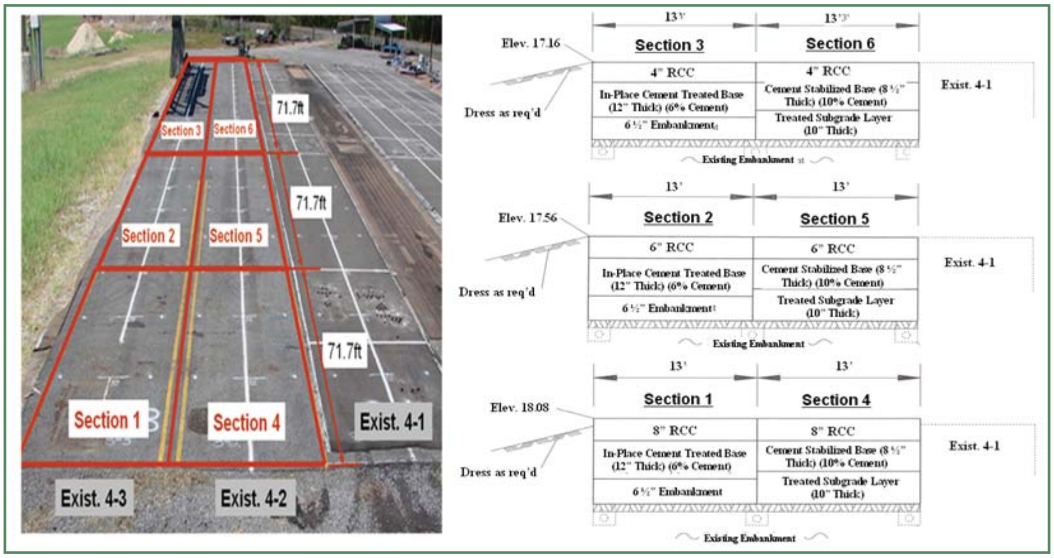

Figure 1
Construction layout and proposed pavement structures

During the construction, in-situ stiffness of bases and subgrade layers as well as surface texture, profile, and smoothness of finished RCC surfaces will be measured by various field pavement tests. Meanwhile, a set of instrumentation devices (e.g., strain gages and pressure cells) are planned to be installed on test sections to monitor pavement responses when subjected to accelerated wheel loading.

Task 4: Accelerated loading of test sections using the ATLAS30

A newly acquired, heavy vehicle load simulation device, ATLaS30 (Figure 2), will be used in the accelerated loading of RCC test sections in this study. Due to high compressive strengths of RCC layers, a wide range of ATLaS30's dual-tire wheel loads (e.g., 6, 8, 10, 12, 16, 20, 25, and 30 kips) is expected to be applied in order to fail each RCC pavement in fatigue cracking within a reasonable time frame. Distress survey and surface texture measurements will be performed at the end of each loading sequence. Load-induced pavement responses and other instrumentation measurements (e.g., temperatures and moisture) will be collected at a pre-designated pass or at the end of each loading sequence.

Task 5: Analysis of the experiment results

The experimental test results will be used to evaluate the structural strength, surface cracking pattern, and roughness of RCC-surfaced pavements. The effect of RCC layer thicknesses on pavement fatigue life will be determined. Based on the analysis results, the RCC pavement life in terms of 18-kip equivalent signal axle loads (ESALs) will be used to compare with asphalt-surfaced low- and high-volume pavement structures. The mechanistic-empirical (M-E) pavement design procedure will be employed in the performance analysis. Finally, a thickness design procedure for RCC-surfaced pavements with a soil cement base will be proposed.

Task 6: Cost-benefit analyses and initiation of recommendations

To demonstrate the benefit of RCC pavements, a life-cycle cost analysis (LCCA) will be performed on a thin RCC-surfaced pavement as an alternative in lieu of asphalt concrete surfacing in a low-volume road design. Based on the LCCA analysis and APT performance results, recommendations on the application of RCC-surfaced pavements in Louisiana will be made.

IMPLEMENTATION POTENTIAL

The results from this research study will provide a cost-effective and durable RCC-surfaced pavement design option for low- and/or high-volume roads in Louisiana, which can be directly implemented by LADOTD.

Figure 2
LTRC-ATLaS30