Florida Department of Transportation Research

An Optimization of a Pavement Instrument Plan for a Full-Scale Test Road: Evaluation

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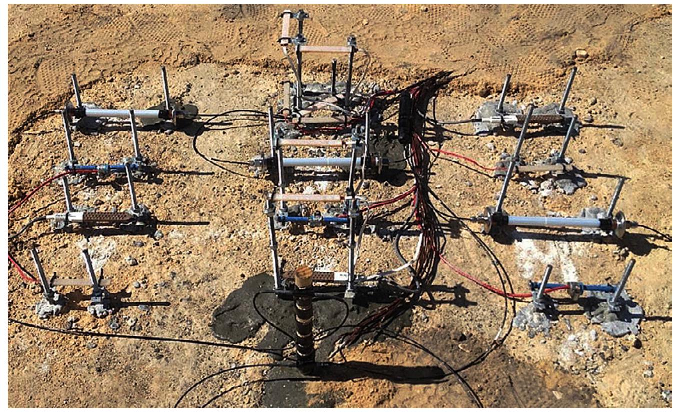
The Florida Department of Transportation (FDOT) has begun planning for a concrete test road that will run parallel to US-301 for 2.5 miles in Bradford County. Test road construction begins in 2016. The road's 52 segments will enable real-world pavement testing and measurement of pavement responses to both dynamic loads, due to traffic, and static loads, primarily due to intense solar heating. Traffic diverted from US-301 for tests will put real traffic flows on the test road. The heavily instrumented road will provide data for developing new construction, rehabilitation, and maintenance strategies and analyzing new cost-effective materials and design methods.

In this project, University of Florida researchers addressed the special challenges posed by the proposed road's location and its data acquisition needs. The 2.5-mile length of the road will require long cables running from embedded sensors to equipment which interprets sensor signals and stores data. Such cables pose two main problems: first, the longer the cable, the greater the electronic noise that reduces signal quality and, second, long cables are more susceptible to damage from lightning strikes.

The researchers investigated the availability and performance of traditional and emerging instrumentation for embedded measurement of concrete strain and temperature. They found that fiber optic sensors possess features that overcome the specific challenges of the proposed test pavement. Therefore, fiber optic cables were chosen for experimental evaluation alongside the copper-based sensors that have been routinely employed by FDOT's State Materials Office (SMO).

The candidate strain sensors were initially evaluated in a series of non-embedded tests to assess their measurement capabilities, noise susceptibility, temperature sensitivity, and ease of installation. Then, a small concrete test slab was constructed for longer-term evaluation of the various sensor types in conditions similar to those of the proposed test road. During the multi-week duration of the test slab experiments, the test slab was exposed to environmental loads and dynamic wheel loads imposed by the Heavy Vehicle Simulator, a vehicle weighing over 50 tons that simulates the passage of many vehicles, accelerating the pavement testing process.



A variety of sensors laid out on subgrade will measure properties of the concrete pavement in which they will be encased.

Strain and temperature measurements were assessed for accuracy, repeatability, and robustness of the sensors. Data from copper and fiber optic strain sensors were similar, but fiber optic sensors allowed more streamlined installation and setup. While fiber optic sensors had higher unit cost, fiber optic data acquisition units read up to 30 sensors per channel, resulting in fewer units for large projects such as the test road. Among other recommendations based on the project, the researchers suggested a hybrid instrumentation plan (copper/fiber optic) to optimize instrumentation costs while ensuring that measurement needs and data quality requirements of the test pavement are met.

Guided by projects like this one, the proposed test facility will be equipped with state-of-the-art tools and provide valuable information, which will lead to better material choices and more durable, lower maintenance highways.

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For more information, visit http://www.dot.state.fl.us/research-center