Florida Department of Transportation Research

Development and Testing of the Miniaturized Pavement Pressuremeter for Use in Unbound Pavement Layers

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Current Situation

The drum roller compactor frequently plays a comic role in cartoons and films, but it plays a serious role in road construction. Proper compaction of soils and aggregate layers is critical to support paved road surfaces. Compaction is monitored with tests like the sand cone test and the nuclear density test (NDT) to determine a material's density. Density is related to the modulus, a critical engineering property of soil and pavement layers, which relates the material's stress-strain properties and the layers response to traffic loads. However, density is not a direct measure of the modulus, so tests are often used in combinations to provide a more complete picture. One of these, the NDT, involves considerable and expensive regulatory, safety, and training programs due to its radioactive source.

This pavement cross-section shows the asphalt surface supported by a layer of compressed aggregate and soil.

Research Objectives

Florida Institute of Technology (FIT) researchers developed a small diameter pressuremeter which provides a direct measure of the stress-strain relationship in pavement layers.

Project Activities

The researchers tested the small diameter pressuremeter (SDPMT) at four locations on and near the FIT campus. Two probe lengths, 6 inches and 12 inches, were developed and tested, allowing either 6-inch or 12-inch unbound aggregate layers to be investigated. SDPMT probes were inserted directly into holes already created for nuclear density testing.

Values such as limit pressures and elastic moduli calculated from FIT SDPMT data agreed well with values produced by a conventional pressuremeter, the PENCEL SDPMT. Also, the FIT version is available in two lengths while the PENCEL version is fixed at 10 inches. SDPMT data were acquired using two types of volume injection tests: incremental and continuous. SDPMT results agreed well with other test types, including 159 SDPMT tests, 96 Clegg impact tests, 141 lightweight deflectometer (LWD) tests, and 107 NDTs. Computer simulations (finite element analyses) conducted to compare SDPMT predicted deflections with LWD measured deflections showed agreement within 10%.

The SDPMT probes could be repaired and maintained much more efficiently than other pressuremeter probes. Continuous volume injection testing with data acquisition using the automated PMT software (APMT) was completed in less than a minute, making this a very useful technique. Stiffness and strength calculated from SDPMT data agreed well with those derived from Clegg and LWD tests. Reasonable correlations were developed using the results from the SDPMT and nuclear density gauge. Tests with the 12-inch SDPMT produced slightly more consistent results than the 6-inch device. Together with NDT, SDPMT can be used to thoroughly categorize the strength-stiffness and density information of roadway base and sub-base layers.

Project Benefits

Testing equipment which is simpler to use and provides faster results can reduce construction time and costs and help to assure quality road construction. These cost savings include elimination of the NDT's regulatory and safety programs. Tests yielding stiffness or modulus results also have the advantage of comparing as-built constructed material properties to those used in the design of the pavement.

For more information, please see www.fdot.gov/research/.