IMPROVING OPERATION OF FDOT TELEMETERED TRAFFIC MONITORING SITES

PROBLEM STATEMENT

The Florida Department of Transportation (FDOT) currently monitors about 7,000 traffic count sites, including over 300 permanent Telemetered Traffic Monitoring Sites (TTMSs). The monitoring equipment generally consists of traffic-actuated sensing devices imbedded in the pavement. These devices capture traffic volumes, vehicle classifications, and truck weights. The data gathered is thereafter downloaded and processed for Annual Average Daily Traffic (ADT), K-factor, T-factor, truck weight, and other pertinent information. This information is used in various forms by different FDOT offices for planning, design, operations, and maintenance activities relating to both highway pavements and bridges. Cellular technology can be utilized to avoid the time and labor intensive process required for downloading the data in the field. However, problems exist with the accuracy and reliability of the communication equipment, as well as with the TTMS sensors.

OBJECTIVES

The primary objectives of this study involved the following:

1) cellular communication improvement for Site 9936
2) a modem performance study
3) telephone line surge protection
4) evaluation of the bonding materials used in piezoelectric axle sensor installation
5) mining Florida ITS data for transportation planning purposes

FINDINGS AND CONCLUSIONS

The cellular communication improvement for site 9936 (located on I-10 about 8 miles east of the intersection of US-441 at the CR-250 overpass) was initiated to correct poor or nonexistent cellular communication. FDOT personnel had to manually download information at this weigh-in-motion site. Solving this problem involved research on available cellular carriers and towers, on-site investigations and tests, replacement of a directional cellular antenna, and changing the cellular provider to improve service and performance. The efforts under this task improved the reliability of the communications with the cellular modem at site 9936. Recommendations for cellular site installations address use and proper installation of high-gain directional antennas to improve signal power, use of low-loss cable between the antenna and the cellular transceiver, and identifying the best cellular provider by locating their nearest tower and obtaining their assistance in aiming the directional cellular antenna.

The modem performance study was performed to mitigate the observed communication problems between the modems in the over 300 TTMS sites and the data collection modems in the FDOT Burns Building. Typical problems include inability to communicate, slow connection speeds, frequent drop of signals, and data errors during transmission. The goal was to determine the causes for the poor performance and the apparent incompatibilities between certain modems. Researchers (1) surveyed available DC-powered modems including specifications, communication protocols supported, and manufacturer's chipset, (2) conducted tests on the modems to quantify performance differences between modems for the purpose of defining specifications for future modem purchases, and (3) examined modem strings defined by the traffic monitoring equipment manufacturers for use on particular modems. Recommended modem specifications and test procedures were developed.

Telephone line surge suppressors protect the modem and other equipment in the TTMSs from current surges generated by lightning. Telephone lines are generally more vulnerable to lightning surges than sensor or solar power lines entering the TTMS cabinets because their long lengths offer greater opportunity for induced or direct strike surges. Historically, the existing surge suppressors have been successful at protecting the equipment, but they have often been damaged or destroyed by surges. Replacing the surge suppressors is expensive, and TTMS data cannot be collected prior to suppressor replacement. The goal was to determine the appropriate specifications and test procedures for identifying surge suppressors that will protect the equipment in the TTMS cabinets from telephone line surges and that will be resilient to surge suppressor failures. Researchers analyzed failed surge suppressors, took field measurements to ascertain surge environment, and tested available telephone line suppressors. They found that number of current surges rather than high current direct lightning strike was the primary cause of suppressor failures. Recommended telephone line surge suppressor specifications and test procedures were developed.

The bonding materials used in piezoelectric axle sensor installations were evaluated to develop test procedures that can be used to test the piezoelectric axle sensor adhesives. This research was also aimed at developing material specifications for selecting adhesives to achieve long-term field performance of piezoelectric axle sensors suitable for Florida traffic, pavement, and environmental conditions. The goal is to reduce failures of piezos at TTMSs and so reduce the high cost of replacements and the attendant disruption of traffic flow. This effort included a comprehensive literature search on the characteristics of epoxies, acrylics, and polyurethanes; a survey of State DOTs regarding their experiences using these adhesives for piezo installations; laboratory testing of the approved adhesives; and long-term field monitoring of ANOVA-designed experiments. Based on the results of this effort, recommended acrylic-based adhesives were identified, and additional testing of one particular epoxy-based adhesive was recommended.

Researchers investigated the potential for effectively mining Florida ITS data for transportation planning purposes. The Transportation Planning Statistics Office recently commissioned a pilot project study on site 750196 at station 36 on the I-4 corridor in Orlando. The study was able, by means of a simple Oracle SQL-based routine, to convert ITS data gathered at this station from minute averages of volume and speed to hourly summaries of volumes and speeds for each lane in both directions at this site. The objective was to develop a mechanism that can be used statewide to capture and convert ITS data into a format compatible with that of TTMS and temporary count sites. This pilot project has shown that it is possible, for incident surveillance and other ITS purposes, to extract planning-compatible traffic data from loops installed on freeways.

BENEFITS

There were several benefits to emerge from this research. First, a host of improvements to communications setups were made, both to particular site operations and to specifications. Alternative adhesives with the potential to increase the long-term performance of piezoelectric axle sensors were identified. The process and mechanisms for capturing and converting ITS data were developed and tested. The FDOT District V Planning Office is currently able to download traffic data composed of hourly volumes from several sites along the Interstate 4 corridor. Furthermore, as a result of this study, FDOT potentially may save $200,000 by foregoing the installation of new loops for collecting planning data in areas where ATMS loops already exist on I-4. With the expansion of ITS activities along Interstate 4 corridor, additional sites will be incorporated thus reducing the need to install TTMS sites along the corridor leading to additional savings.

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