HIGHLIGHTER

ODOT RESEARCH

CONTINUOUS FRICTION MEASUREMENT EQUIPMENT (CFME) FOR HIGHWAY SAFETY MANAGEMENT IN OKLAHOMA

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PROJECT TITLE
CONTINUOUS FRICTION MEASUREMENT EQUIPMENT (CFME) FOR HIGHWAY SAFETY MANAGEMENT IN OKLAHOMA

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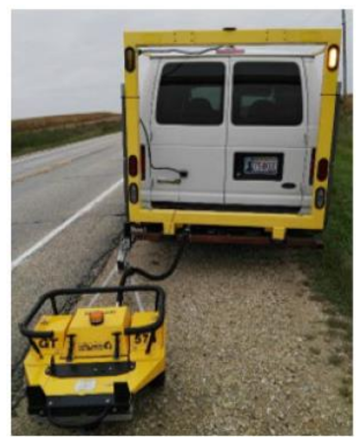
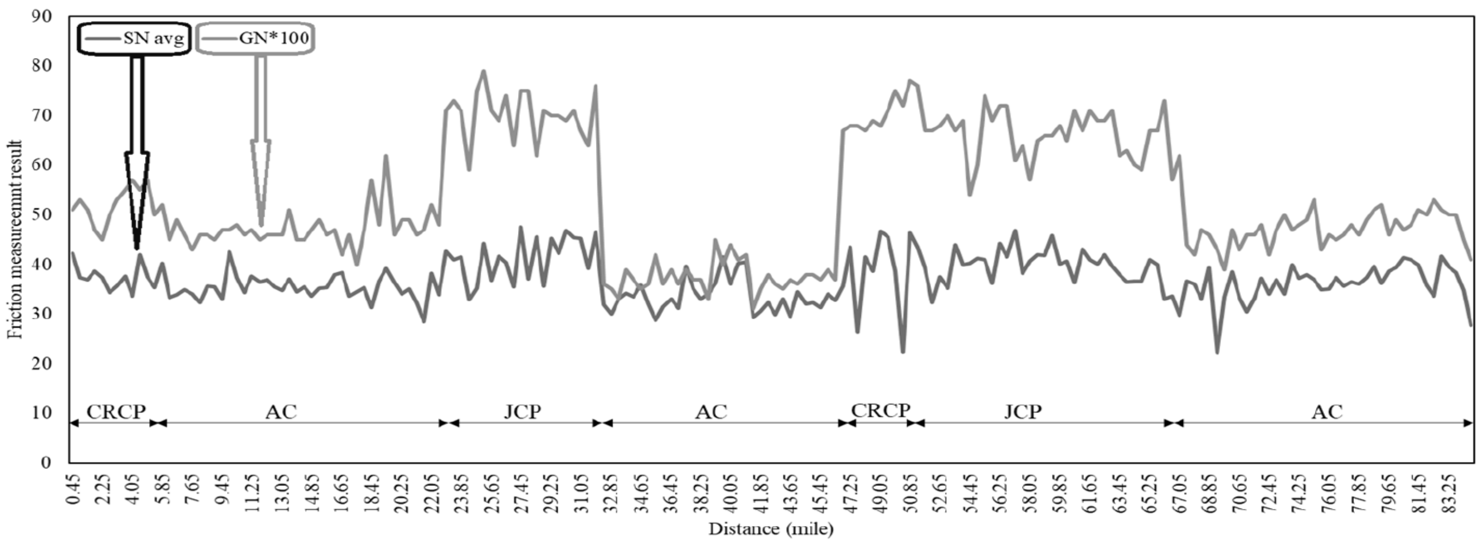
OVERVIEW Skid resistance of pavements plays a significant role in road safety as the friction between tire and pavement surface is a critical contributing factor in reducing potential crashes. Therefore, it is important that Departments of Transportation (DOTs) monitor the friction performance of their pavement networks in a systematic manner and establish Pavement Friction Management (PFM) programs. A proactive friction management program can help identify areas that have elevated friction-related crash rates, investigate road segments with friction deficiencies, and prioritize use of resources to reduce friction-related vehicle crashes in a cost-effective manner. Research is needed to evaluate the capabilities of continuous friction measurement (CFME) devices and corresponding ability to support PFM programs in Oklahoma.



RESULTS An important part of the PFM process is the selection of the most appropriate friction measuring equipment. In this project, the capabilities of the Grip Tester (shown right), a type of CFME device, and its ability to provide information to support PFM programs were evaluated based on comprehensive field data collection. The Grip Tester (GT) has been used extensively in the UK and Germany. It continuously measures the longitudinal friction along the wheel path and operates at a fixed slip ratio at highway speeds using users defined water film thickness. The friction measurements are recorded at an interval of 3-ft (0.9 m) by default or another value set by the users. Because CFME devices are developed based on the modern anti-lock braking systems (ABS) technology, the friction measurements from CFME may not correspond precisely with historical data collected with locked-wheel trailers. Although CFME provides information with greater details about spatial variability of pavement friction, processing large amounts of data may be cumbersome and time consuming at this time due to the lack of available practical software for roadway applications.

Working closely with ODOT, asphalt and concrete testing sections with various surface characteristics (texture and materials) were selected in Oklahoma as the testing bed for the implementation of Grip Tester. Various operational characteristics of a GT were integrated into the field data collection to evaluate the CFME friction measurements. The data collected at the sites along with

Oklahoma crash data were further used to assess the operational characteristics and repeatability of CFME friction measurements, to compare the measurements from locked-wheel friction trailer and Grip Tester, and to develop enhanced crash rate prediction models. Various statistical and comparisons analyses were performed, suggesting that CFME can acquire repeatable and reproducible friction profiles. The friction measurements from the Grip Tester (expressed as GN in the figure) and the locked-wheel skid tester (LWST) (expressed as SN) were tested to be statistically correlated. Three types of pavements were tested: asphalt concrete (AC), jointed concrete pavement (JCP) and continuously reinforced concrete pavements (CRCP). The SN value is not as sensitive as the GN to the change of pavement types. Since LWST used ribbed tires during testing, its measurements are more sensitive to the surface micro-texture performance, while the friction on JCP and CRCP are primarily provided by their macro-texture components resulting from surface grooving. As a result, the Grip Tester recorded much higher friction numbers on concrete pavements. Per the figure, pavement surface type seems to be a significant factor to correlate SN and GN.



In addition, several potential implementations of CFME data were discussed for PFM and highway safety applications. Combining the CFME and pavement condition data sets collected from this project with the Oklahoma safety database, updated Safety Performance Function (SPF) was developed to improve the prediction accuracy of expected average crash frequency. With detailed CFME data, pavement network could be better segmented into homogenous sections for road maintenance scheduling and management. Several algorithms were tested for this purpose. In addition, to ease the use of CFME data, a CFME data analysis software interface was developed, which can upload and visualize CFME measurements, and perform statistical and comparison analyses for data reporting.

It is recommended that ODOT should consider adopting CFME for their skid resistance program. Through a wide range of measurements and analysis, an in-depth understanding of the testing methodology could be achieved to (1) quantify the effect of operational factors, and (2) establish standard testing condition and approaches. Several challenges and opportunities remain for the wide implementation of CFME for friction management and roadway safety practices. The Grip Tester has been proved by several studies to be an accurate and economical way to measure skid resistance on roads. Meanwhile, it is also found that the variations of measurements could be high on segments with bad surface conditions (such as high IRI, faulted roads) while traveling at highway speed. To note, variation is common among all friction equipment.

POTENTIAL BENEFITS This project provides a comprehensive evaluation of a continuous friction measurement device (Grip Tester) that can support pavement friction management programs in Oklahoma. The results of this project can assist ODOT in minimizing friction-related vehicle crashes by ensuring that pavements provide adequate friction properties.