Data Cleaning of Skid Resistance Data from the LTPP Database

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Abstract

The material in the pavement can determine how much pressure and weight it can handle, which in turn impacts skid resistance. Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface. Measuring skid resistance is crucial because it can indicate the frequency of maintenance to ensure roadway safety. One measure of skid resistance is a skid number. The skid number is specified based on a standard test procedure and apparatus as in ASTM (American Society for Testing and Materials). One of the tests to obtain the skid number involves a locked wheel skidding along the tested surface to measure friction resistance. Although many U.S. states deem a skid number under 30 to be unacceptable, this standard to control skid resistance is not consistent nationwide.

It was crucial to examine the information from the Long-Term Pavement Performance (LTPP) program website to understand better the variety of measures that different U.S. states use to determine which skid numbers are acceptable for frequency of maintenance. The LTTP program collects pavement performance data using standard data collection procedures and protocols on various pavement types. This project aims to clean, process, and understand the data based on factors that can impact skid resistance.

Background Information

More on Skid Resistance and Measuring It

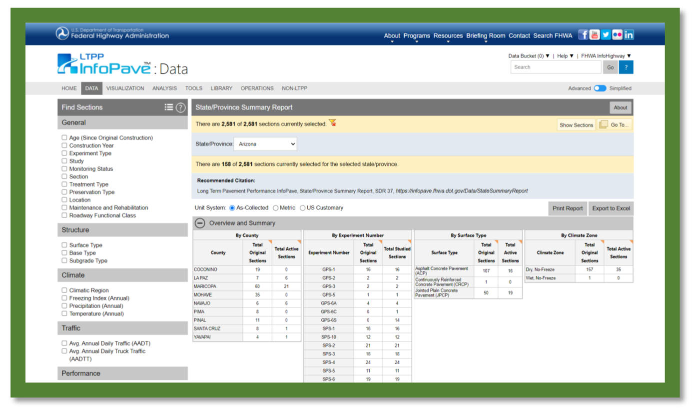
One phenomenon that contributes to friction between the tire and the pavement is adhesion. In this context, adhesion refers to intermolecular binding or adherence at the surface level, specifically how the tire's rubber and the pavement's macrotexture interact. Although there are different methods to measure skid resistance, a commonly used method is a locked wheel tester. Measuring begins by spraying water ahead of the test tire to create a wet pavement surface. After that, the test tire braking system is activated to lock the test tire. Finally, the skid number is recorded from the force between the test tire and the pavement, examining different testing speeds.

Specific Factors Impacting Safety and Skid Resistance

Skid resistance is an important property of pavement surface since it is directly connected to the ability to control vehicle movement in situations that can endanger the driver's safety. In wet weather, like rain, the layer of water covering the pavement acts like a lubricant and reduces the contact between the tires and the pavement surface. This leads to smaller energy loss, creating less friction. Additionally, the higher the traffic volume, the more extensive the polishing action and the reduction in skid resistance, especially for heavy vehicles.

Research Methods

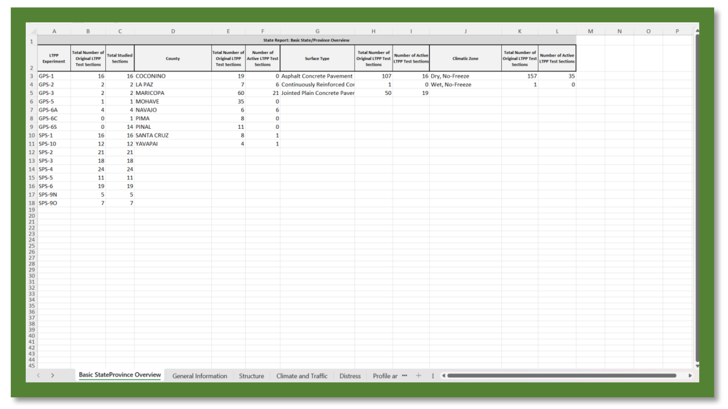
Before examining the data in greater detail, the initial step was to understand the database that would be implemented. Creating a new dataset based on the skid resistance in each area in the U.S. involves two different data sets: the State/Province Summary Report and the Ancillary Data Selection and Download. The State/Province Summary Report includes the section IDs of each roadway in the study, whether the section serves urban or rural areas, average yearly traffic, and climate. The Ancillary Data Selection and Download include each section's skid number and the method used to perform the test. The input variables for the dataset included materials, pavement structure, climate, and traffic. The output variables include distress (a measure of stability), profile (comfortability or smoothness of the ride), and deflection (seeing how much the pavement vibrates based on small stresses).



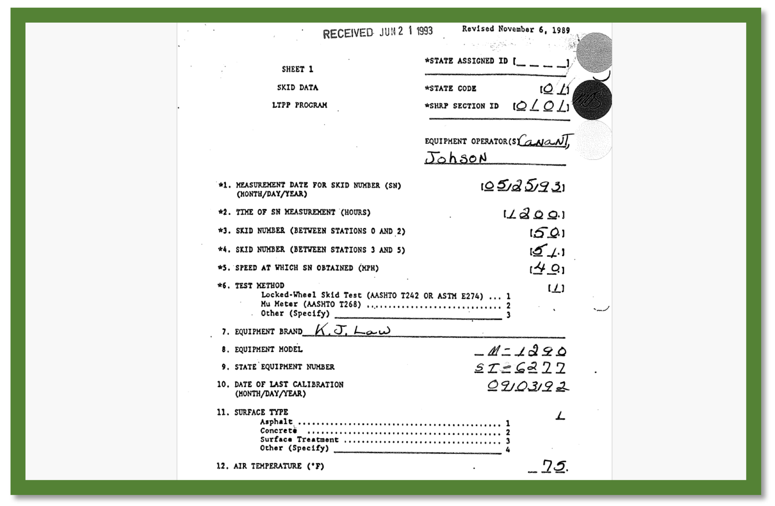
Screenshot of Arizona's State Summary Report

After going onto the Long-Term Pavement Performance (LTTP) website, the State/Province report can be exported as an Excel file containing the section IDs for the state selected, in this example, Arizona. This page also gives the number of the sections tested in each county within this state.

The Excel file has multiple sheets detailing specific parts of each section's data, such as Structure and Distress. General information and structure sheets will be used for the dataset that will be created within this project. This is to connect the materials to each of the sections and understand the skid resistance data from the Ancillary Data Selection.



Screenshot of Arizona's State Summary Excel File



Screenshot of one of Arizona's section skid resistance test

Navigating to the Ancillary Data Selection and Download page of the LTTP website, there a set of selectors to download the specific data that is needed. Friction Data was selected, and it provides scanned paper copies of the each of the skid test performed. It was important to look at each of the sections that the test were performed on and accurately write the skid number.

Discussion

One crucial insight was that understanding data is a much more involved process. Throughout the project, the focus was on beginning with analyses and analyzing the data rapidly. After examining all of the different confounding variables to consider in the project, it was essential to reframe the focus. Rather than beginning with analysis, the focus can be on understanding and organizing the dataset based on understanding the data in great detail.

A significant challenge arose when working with handwritten data. The tests were taken using different methods and dates for all downloaded skid resistance data. Although this caused some inconsistency in the dataset, it was essential to determine which data was valuable within the scope of this research.

As this is part of an ongoing research project, and the data will be used for further analyses and models, ensuring that the data is solid has become increasingly crucial. Because "safe" skid resistance is different for each state within the U.S., the work from the research progress can provide context to aspects such as traffic and climate to understand the specific area and the specific resources to resolve pavement issues.

Acknowledgments

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