Highway-Rail Grade Crossing Surface Material Performance

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Highway-Railroad grade crossings are an integral part of the transportation system and the one location for potential conflict between road and rail traffic. Performance of the surface material at grade crossings is an ongoing challenge. A study, conducted by Michigan Tech's undergraduate students reviewed the literature available on grade crossing surface materials and crossing records available from MDOT in an attempt to determine which surface materials perform best for given traffic levels and site conditions. The study team found that the data currently available was not adequate to perform credible analysis of the situation, and developed a recommendation for a new grade crossing data collection process for MDOT. The team also made recommendations on improving the rating system used by MDOT inspectors for crossing surface condition.

Introduction

Grade crossings are a common theme throughout the United States highway network, in the State of Michigan alone there are over 4,000 documented crossings. These crossings must be maintained to provide a safe environment for both motorist and train traffic. Many high-volume crossings may see thousands of vehicles and 60-80 trains per day. This highlights the need to provide a quality structural design and maintain high safety standards. Federal Highway Administration (FHWA) standards define the required safety devices at a grade crossing, but the structure of the crossing, and the choice of surface material, is normally decided by the railroad company owning the rail line or the responsible roadway agency. The objective of this project was to evaluate different crossing surface materials and determine the one(s) that have had satisfactory performance over time.

Results

The research team selected 107 grade crossings across the state, intended to illustrate the variety of crossing surface materials in use. A visual inspection was performed, and MDOT history files were collected for each of the crossings. The MDOT history files were examined manually, and a spreadsheet was developed including the following data fields: Date of inspection; Crossing surface material; ADT; % Trucks (in ADT); Surface rating; and train speed. The crossings were divided into four categories of Concrete, Asphalt, Timber, and Rubber. A graph of inspection year vs. rating was created for each crossing from the history provided. To avoid scaling issues, the year was graphed horizontally, with each graph showing the same range, from 1994 to 2013, to cover all the data included in the history. The graphs included a vertical scale of 1-5, with integer values only, to correspond to the possible rating values.

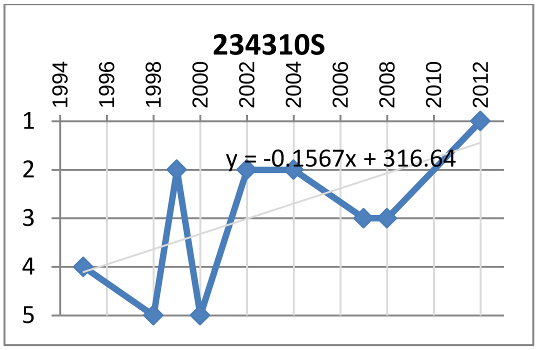

Figure 1, Inspection Rating Graph for Asphalt Crossing 234310S

The evaluation of the data and graphs led to the following conclusions:

- Very few historical records included a complete crossing life cycle from one reconstruction to the next
- Although graphs show changes in ratings, there is no causal data to go with the records, so the reasons for the changes cannot be reliably determined
- It appears that a rating change of one point in either direction for a single rating period may have no real significance. With no rating criteria two different inspectors could rate the same crossing differently on the same day.

The research revealed that shortcomings of data collection and rating process made evaluation of surface performance evaluation impossible. As a result, the team concentrated on improving the process, so institutional knowledge on performance can be improved. They developed a data collection protocol for grade crossing inspections that involves both historical research to find and document techniques during construction and collection of additional data during inspection. The protocol also includes a quantifiable inspection rating to document crossing performance across time, modeled after the PASER system developed by the University of Wisconsin-Madison (Table 1).

Table 1, Crossing Rating System for Concrete Crossings

Concrete
1 - Excellent
New Construction or Recent Reconstruction
No Defects
No Action Required
2 - Very Good
Joints all in good condition
Minor Surface defects - pop outs, map cracks
Light Surface wear
3 - Fair
First signs of crack or joint faulting up to 1/4"
First signs of joint or crack spalling
Moderate to severe scaling or polishing 25-50% of surface
Minor spalling from reinforcement
Multiple corner cracks
Fasteners loose, but not projecting above surface
4 - Poor
Severe cracking or joint faulting up to 1"
Many joints, transverse, meander cracks open, severely spalled
Extensive Patching in poor condition
Occasional holes
Fasteners loose, projecting < ¼” above surface
Loose panels, no vertical displacement
5 - Very Poor
Extensive and severely spalled cracks
Extensive failed patches
Joints failed
Restricted speeds
Loose panels, vertical displacements between panels, > ½”
Loose fasteners, projecting > ¼” above surface

Recommendations

Completing the research originally envisioned in this project will require data collection over an extended period of time. The tools developed in this project could enhance the inspection process and provide a statistically viable data set for future research efforts.

While the available data does not allow a comprehensive analysis of surface material performance, it appears that subsurface preparation impacts surface performance more than the surface material used. Some crossings from each of the categories investigated appeared to perform well over time while others failed relatively quickly.

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