Joint Transportation Research Program

Principal Investigators: Tommy Nantung, Purdue University, tnantung@indot.in.gov, 765.463.1521 x248
Seonghwan Cho, Purdue University, scho@indot.in.gov, 765.463.1521 x252
Program Office: jtrp@purdue.edu, 765.494.6508, www.purdue.edu/jtrp
Sponsor: Indiana Department of Transportation, 765.463.1521

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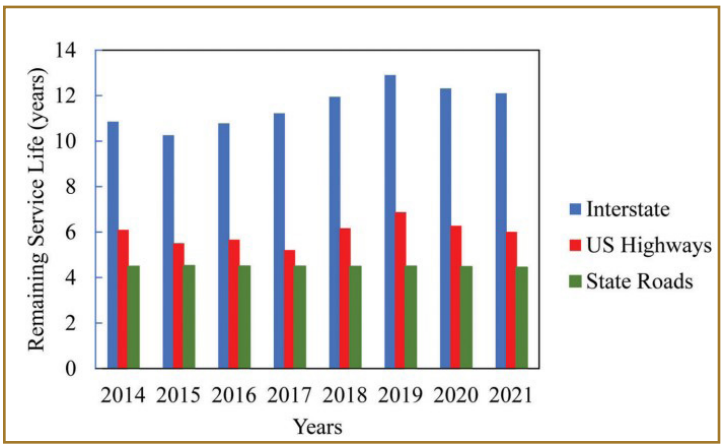
Performance Acceptance and Performance Monitoring of Pavement Using Falling Weight Deflectometer (FWD) and International Roughness Index (IRI)

Introduction

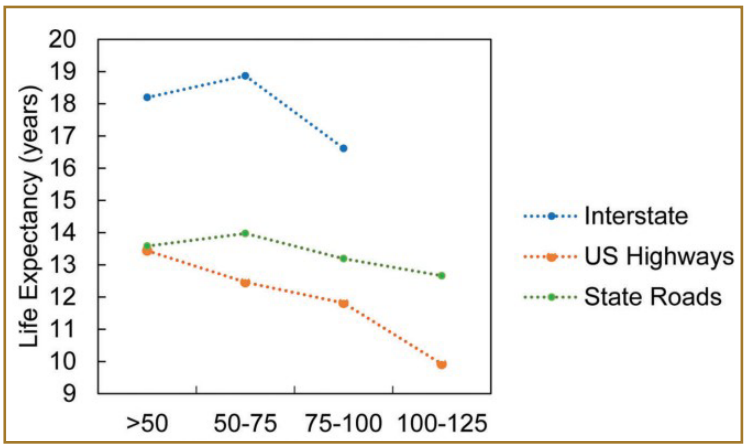
The Indiana Department of Transportation (INDOT) primarily evaluates pavement layer properties individually, which limits their ability to predict long-term pavement performance. This layer-by-layer approach does not account for the integrated system behavior required for effective load distribution. To bridge this gap, different performance-based indicators, such as the International Roughness Index (IRI) and Falling Weight Deflectometer (FWD), offer the potential for holistic performance evaluation. These surrogate test methods capture both structural and functional pavement responses, which aid in system-level monitoring. This study developed practical predictive models for pavement deterioration and remaining service life (RSL) estimation using historical IRI and FWD data. The study also developed a performance-based acceptance framework for better pavement management by defining acceptable structural and functional performance limits, thus enhancing decision-making in scope, design, and preservation.

Findings

- Higher initial IRI values lead to accelerated deterioration, underscoring the importance of achieving low initial roughness levels during construction.
- Interstate highways exhibited the slowest rate of



Remaining service life evolution for different road classifications over the years using an IRI failure threshold of 150 (in./mile).



Flexible pavement life expectancy and average IRI values.

IRI increase, reflecting robust structural designs and quality maintenance practices. U.S. highways showed a moderate IRI rate increase, and state roads experienced a slightly faster rate of IRI increase.

- The IRI value ranges for U.S. highways and state roads were similar, indicating comparable levels of smoothness across both classifications, though both were noticeably rougher than interstate highways.
- Interstate highways consistently demonstrated the highest life expectancy across various IRI ranges. U.S. highways and state roads exhibit similar life expectancies and maintenance requirements.
- The relationship between surface curvature index (SCI) and IRI values varied across road types, with U.S. highways and state roads showing a comparable increase in IRI as SCI increased. Interstate highways exhibited a significantly smaller increase.
- Factors such as higher traffic volumes, heavier loads, and frequent maintenance strategies can influence the relationship between SCI and IRI, particularly for interstate highways, where different structural distress may impact IRI but are not well captured by SCI.

Implementation

These report findings can be implemented to enhance pavement longevity and performance in several ways. First, INDOT can incorporate pavement preservation treatments at both the network and project levels to ensure that construction practices prioritize achieving lower initial IRI values, as higher initial roughness accelerates pavement deterioration. Additionally, adopting pavement preservation treatment performance models within the pavement management system will enable maintenance strategies to be tailored based on highway classification, even when IRI values appear similar. Since the SCI-IRI relationship varies by road classification, the use of the remaining service life concept in strategy evaluation and project selection will help ensure that maintenance decisions account for both structural integrity and surface condition. Finally, integrating the pavement preservation framework into the network-level pavement management system will enable the inclusion of structural evaluations alongside surface condition monitoring, which leads to more accurate and data-driven maintenance decisions.

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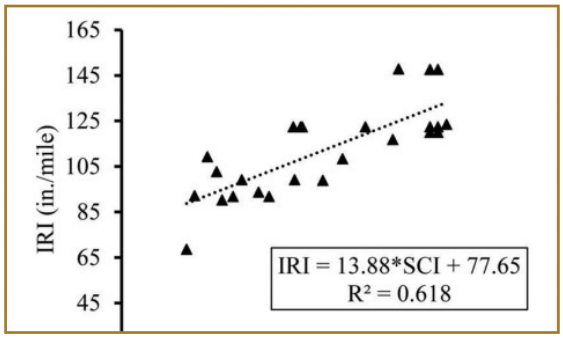

Relationship between SCI and IRI for state roads.