LIFE CYCLE AND ECONOMIC EFFICIENCY ANALYSIS PHASE II: DURABLE PAVEMENT MARKINGS

Problem

The Maryland State Highway Administration (SHA), in its continuing efforts to provide superior guidance to motorists by clearly defining traffic lanes during day and night, continues to investigate and research pavement-marking products that are dependable, durable, and effective. Evaluations are necessary to determine whether new pavement marking products (or existing products from new manufacturers) are suitable for use on Maryland highways, and to ensure statewide fairness and consistency in the evaluation of these products.

Objective

The objectives of this project were to ensure proper procedure and to evaluate the effect of various inputs (traffic volume, snow, rain, etc.) on the desired outputs (durability and retroreflectivity) for two durable pavement marking materials, inlaid tape and thermoplastic. The research team used the collected inputs to produce general equations that would estimate each material's retroreflectivity, life cycle, and economic efficiency.

Description

The state of Maryland was divided into three regions (western, central, and eastern) because of the regions’ different weather, topography, and traffic characteristics. Six different locations throughout the state were selected for data collection, and the data was collected for three or four years.

The input variables for the retroreflectivity estimation were cumulative traffic amount, cumulative precipitation, and cumulative snowfall. In order to estimate the future retroreflectivity properly, this research tried four different basic regression equations: linear, nonlinear, linear log, and nonlinear log.

In order to estimate the materials' life cycles, threshold retroreflectivity values based on the different design speeds of the roads were necessary with estimated retroreflectivity under certain traffic and weather conditions.

The traffic and snowfall amounts were specified into three typical categories (high, medium, and low). The nine combinations of those categories were the conditions used in the life cycle estimations as examples in this research.
In this research, total installation cost included the financial, delay, and accident costs caused by the installation process.

Results

- The linear function best fit the relationship between the collected retroreflectivity and input variables.
- Because of the field data's inconsistent nature, the adjusted R-square values, which show how well the function fits the actual data, were not very high. However, the values were still higher than those found in similar research because of the inclusion of weather and traffic data. Traffic data was the sole conventional data used in the other life cycle studies of the pavement markings.
- Snowfall amounts affected retroreflectivity more than traffic amounts did. This indicates that snowplow use must be regulated and standardized in order to improve the pavement markings' performance and life cycles.
- Because of its higher initial retroreflectivity, inlaid tape markings generally lasted longer than thermoplastic pavement markings.
- Because inlaid tape's initial retroreflectivity was higher than thermoplastic's, white inlaid tape lasted longer and was more durable than white thermoplastic. However, yellow thermoplastic was as durable as yellow inlaid tape.
- The estimated total installation costs were $3.168/ft for inlaid tape, $0.777/ft for thermoplastic, and $0.148/ft for waterborne paint.
- Although inlaid tape was more durable, thermoplastic was more economical under most conditions because of inlaid tape's higher installation costs.
- To make the inlaid tape competitive to thermoplastic in terms of economic efficiency, the sensitivity analysis showed that inlaid tape's life cycle had to be increased by 50 percent or its total installation costs had to be reduced by 40 percent.

Report Information

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