Autonomous Vehicles:
An Assessment of the Implications of Truck Positioning on Flexible Pavement Performance and Design

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Outline

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Introduction

• Autonomous Vehicles (AVs) partially or fully drive themselves.

• Benefits of AVs include:
  • Reductions in accidents, pollution, cost of congestion;
  • Enhanced highway capacity and mobility.

• Autonomous Vehicles technology has already matured to a point of commercial introduction.

Licensed issued for autonomous trucks (AT) of Daimler to operate in public roads of Nevada
Problem Statement

Truck Distribution

Distance from the outer edge of the wheel to the pavement marking

Non-AT

AT

Frequency (number)

Wheel location (in.)
The objective of this study is to quantify the effect of controlled autonomous truck traffic on asphalt pavement performance and design.
Methodology

- Scenarios
  1. Only non-AT
  2. Integration of AT and non-AT (0 to 90%)
  3. Full segregation of AT and non-AT (similar to HOV lanes)
  4. Full AT Scenario (100%)

Performing Mechanistic-Empirical Pavement Design Guide (MEPDG) software to evaluate the pavement thickness.

\[
AADTT_{Design} = AADTT_{Design} \times DD \times LD
\]

- \(DD\) = Design distribution
- \(LD\) = Lane distribution
Evaluation of damage profile for normal and uniform distributions

- Normal Distribution, Wander=10 in
- Uniform Distribution
- Wander= 0

\[ \text{AADTT}_{\text{ENAT}} = \text{AADTT} \times \text{EF} \]

- The equivalency factor (EF) was determined to be \(0.82\).
Results and Discussion

Segregated Scenario

Integrated Scenario

Modifying Lane Distribution to Account for Increased Flexibility
Life Cycle Cost Analysis

Urban Cases

Rural Cases
Conclusions

• The potential for benefits of autonomous trucks stems from the ability to more systematically control the positioning of autonomously trucks and more uniformly utilize the available pavement surface.

• With respect to pavement damage, a single pass of a truck that follows a uniform distribution across the travel lane is equivalent to 0.82 passes of one that follows a normal distribution.

• The inclusion of autonomous trucks was found to improve the overall performance or reduce the required design thickness of pavements.

• Life cycle cost analysis showed that the incorporation of autonomous trucks could reduce the cost of pavements, particularly the initial construction cost.
References


Thank you