**Introduction**

This study compared the excess fuel consumption due to structural response (EFC)* with a pavement with no structural response, and also compared EFC, with the effects of roughness and macrotexture on EFC*. EFC was calculated using three different models for a factorial including 17 asphalt surfaced pavement field sections on the California state highway network with different structure types that were characterized for their viscoelastic properties. The results of the modeling were used to simulate annual EFCs for a factorial of vehicles, traffic flows, speed distributions and climate regions typical of California.  

*EFC: Additional fuel required to propel a vehicle compared to an “ideal” pavement (baseline pavement).

**Problem Statement and Study Goals**

The structural response energy dissipation models have not been compared with each other for the range of pavement types, vehicles and climates in California, or validated with comprehensive field data. The importance of EFCs considering the interactions of pavement structure, wheel load, temperature, and speed (urban vs rural) across typical ranges for California have not been documented.

**Goals**

- Compare different pavement structural response energy dissipation models and the results they provide for estimated excess fuel consumption (EFC) for a range of California pavements, vehicles and climates using well characterized and documented field test sections.
- If warranted by the results of the first goal, verify the same models using the results of the field measurements with instrumented vehicles (currently underway).  

**Pavement Test Sections**

- Jointed plain concrete with and without dowels ***
- Continuously reinforced concrete ***
- Asphalt pavement with and without rubberized surfaces and open-graded surfaces
- Semi-rigid pavement

*** assumed to have no EFCs for preliminary comparison

**Results**

The structural response energy dissipation models have not been calibrated using the results of the field measurements with instrumented vehicles (currently underway).  

**Conclusions and Recommendations**

- For 17 sections analyzed
  - Structural response excess fuel consumption (EFC) ranges from 0.03 to 0.92 ml/km/veh, with 50% of sections between 0.08 to 0.26 ml/km/veh for OSU
  - Highly dependent on model used
  - Three models are not consistent across sections
  - Roughness and macrotexture EFC&M from 0.15 to 0.35 ml/km/veh
  - Most sections selected for IRI less than 100 in/1.6 m/km
  - Roughness about 10 times more important than macrotexture
  - Roughness + macrotexture about 5 x greater than structural response for sections with IRI about of 90 in/mi
  - For climate regions and traffic across 17 sections analyzed
    - Temperature (climate regions) generally more important than speed (urban vs rural) across typical ranges for California
    - Load very important, reflected in sensitivity of EFCs
    - Highly dependent on model used
    - No clear trend between structures (flexible, semi-rigid, composite)

**Recommendations**

- Do field fuel economy measurements.
- Improve modeling for the concrete pavements, consider multiple layers in rubberized asphalt.
- Calibration should focus on the most sensitive variables: (pavement structure, wheel load, temperature, and speed)
- Consider interaction of roughness and structural responses
- Check the EFC models by including rough sections.

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