

Pavement

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Project Title:

Validation of Greenhouse Gas Emissions from Pavement Deflection

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Validation of Greenhouse Gas Emissions from Pavement Deflection

Investigate the effect of pavement structural response on the vehicle energy consumption and emissions

WHAT IS THE NEED?

Caltrans was approached by industry to account for the extra energy used by vehicles (e.g. cars, trucks) overcoming the deflection of the pavement underneath the wheels. A preliminary phase of this study involved review of the different models and data collection to characterize of dynamic properties of pavement on a set of California test sections. Three universities (Massachusetts Institute of Technology, Michigan State University, and Oregon State University along with UCPRC participated in this project and used three different models to predict the effect of pavement structural response on vehicle fuel use. From preliminary modeling results, the effect of pavement structural response on vehicle fuel consumption though is small but it affects each vehicle on the road and becomes significant when life cycle of the road transportation is considered.

WHAT WAS OUR GOAL?

This study is to investigate the effect of pavement structural response (with the effects of roughness and texture included) on the vehicle energy consumption and emissions. This phase measures field vehicle fuel consumption on a set of pavements and finalizes the development of calibrated and validated models for vehicle energy consumption studied in the first phase.

WHAT DID WE DO?

1. Measure the field fuel consumption on various pavements for different types of vehicle.
 - Vehicles: heavy truck, medium truck, SUV and medium car.
 - Asphalt and concrete pavement with different deflection, roughness, and texture.



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2. Isolate the effect of pavement deflection on vehicle fuel consumption from other factors (aerodynamic force, gradient force, rolling resistance from roughness and texture, inertial forces, etc.).
3. Calibrate and validate models for vehicle fuel consumption due to pavement deflection.

WHAT WAS THE OUTCOME?

The data required for calibration and validation of structural response models is collected, cleaned and complete. Two universities have submitted the forward modeling results (MIT and MSU). OSU will be submitting its results in 2 months as it requires fast dedicated computers and multiple FEM software for the simulations. As soon as all results are collected, a mechanistic empirical analysis using the fuel consumption model (HDM4) will be calibrated. The three models will also be validated and calibrated with the data that has been collected.

WHAT IS THE BENEFIT?

Along with the construction and smoothness models the more accurate, validated pavement deflection model will be incorporated within Pavem to calculate greenhouse gas potentials as the network is preserved and rehabilitated. Such precise model will also be used in life cycle assessment tools that will be able to better quantify energy and environmental impacts.

IMAGES

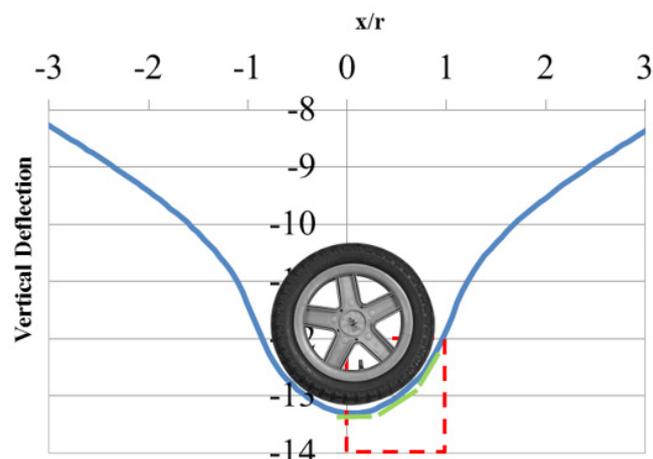


Image 1: Exaggerated pavement deflection model

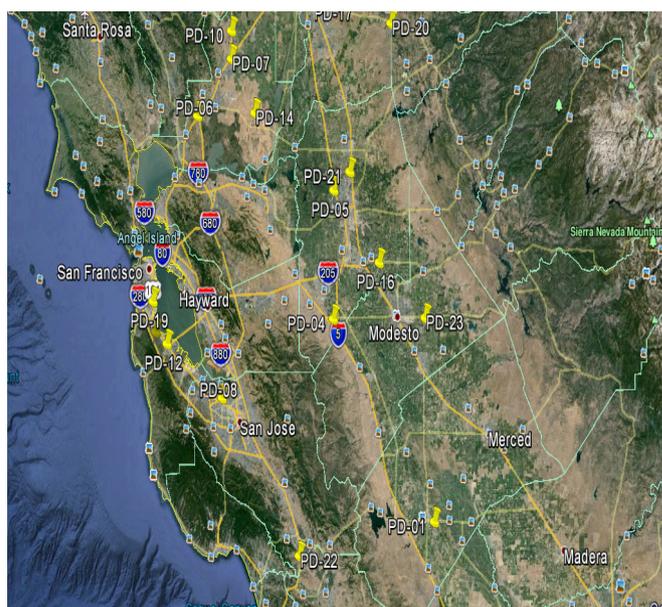


Image 2: Map of field test locations

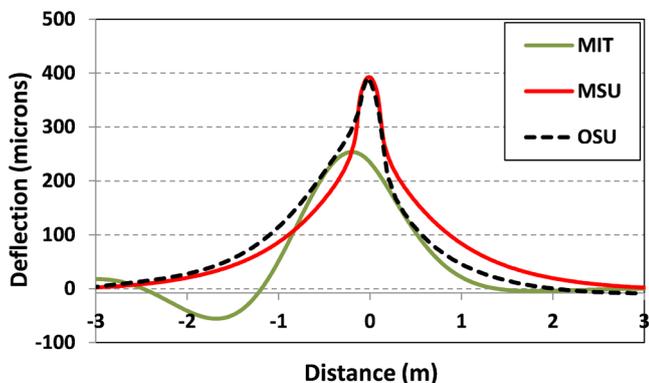


Image 3: Typical evaluation of deflection bowls between models

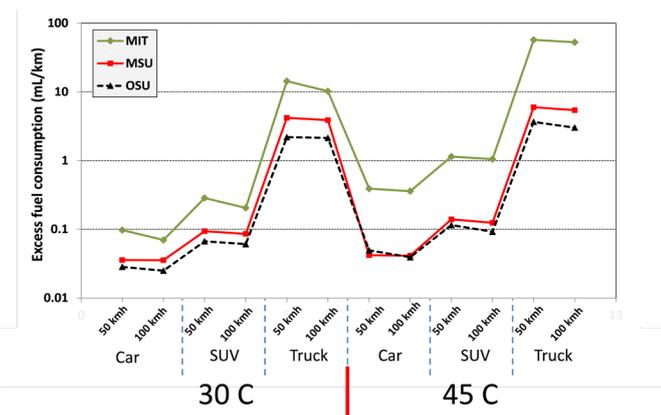


Image 4: Typical fuel consumption on a section (winter and summer)

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