Transportation Pooled Fund Study TPF-5(197)
The Impact of Wide-Base Tires on Pavements - A National Study

DRAFT Statement of Work

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Background

Various research studies investigated the potential pavement damage of wide-base tires as compared to regular dual-tire assemblies with many drawing the conclusion that they are more damaging to pavements. However, until the past five years, all the research studies documented in the literature were conducted on early generations of wide-base tires, which may not have been intended for highway use. The early research results may, in part, account for the lack of wide-base tire adoption in the USA due to inconsistent State restrictions on these tires, which hinder interstate commerce.

Recent advances in tire technology have led to the design of wide-base tires that have wider tread than previous designs, resulting in a load distribution more comparable to that of dual tires. Therefore an evaluation of these new tire designs is needed to determine their contribution to pavement damage and other factors, such as safety and economics, with respect to dual configurations.

There is also the issue of the discrepancy between the reported width on the tire and the actual tread width. From an enforcement perspective, it is much easier to read the width of the tire than to measure it and from the pavement's perspective, all that contributes to damage is what with which it contacts.

The US Environmental Protection Agency (EPA) Smartway Transport Partnership promotes the use of wide-base tires as a way to improve fuel economy by way of reducing weight, aerodynamic drag and rolling resistance. Other potential benefits they cite are reduced drive-by noise and improved stability.

FHWA and the Asphalt Research Consortium sponsored an international workshop on the use of wide-base tires at the Turner-Fairbank Highway Research Center (TFHRC) October 25-26, 2007. The outcome of the workshop can be found here http://www.arc.unr.edu/Workshops.html. The research needs identified support this project.

Trucking operation factors that directly affect pavement damage can be classified into three major components: vehicle-generated load, axle and tire configuration transferring the load, and pavement carrying the load. To fully characterize the damage induced by different tire and axle configurations, the effects of vehicle, tire, and pavement and their interaction must be considered. Vehicle and tire factors include axle loads, axle spacing, speed, tire inflation pressure, and tire configurations. Pavement parameters include surface roughness, materials properties, layer thicknesses, and subgrade strength.

The recent introduction of the Mechanistic-Empirical Pavement Design Guide (MEPDG) has shifted the emphasis in pavement design from empirical methods to more rational approaches. Therefore, the impact of different vehicle-tire factors on the pavement damage need to be determined using rigorous theoretical modeling

capable of simulating field conditions and should be validated utilizing field test response measurements.

Objectives:

1. Quantify the impact of vehicle-tire interaction on pavement damage utilizing advanced theoretical modeling that is validated via full-scale pavement testing. This includes the determination of the relative effects of wide-base tires and dual-tire assemblies on pavement performance. This should also include determining the relationship between the reported tire width and aspect ratio, load, inflation pressure and actual tread width.
2. Develop a tool and methodology that allows states to assess the impact of wide-base tires on the pavement network.
3. Perform an analysis of the economic, safety, and environmental effects of using wide base tires relative to the impact on pavement performance.

Scope of Work:

The study will examine the effect of wide-base and dual tires with variable axle configurations on flexible pavements of varying structural geometry and capacity. Only wide-base tires currently available in the US market of a width greater than 425 mm will be considered. All tire manufactures will be invited to contribute to the study, as well as international partners and other Federal agencies. Economic, environmental and safety factors will be evaluated based on available data, but not tested as part of the physical experiment or analytical modeling. A methodology will be delivered along with all documentation allowing states to assess their policy on the use of wide base tires on their pavement networks relative to pavement management, safety, commerce and environmental factors.

Approach

The specific approach will not be specified here, but it is anticipated that the progression of this effort will follow a logical sequence as described here:

A comprehensive literature review and synthesis on past and current research will be conducted on the factors relevant to the objectives and scope of the project. Based on that review, the research team shall propose an experimental plan and modeling framework to quantify pavement damage due to tire and axle configurations. The plan will describe how the pavement damage findings may be considered in the context of the pavement management, safety, commerce and environmental factors.

Upon approval of the plan by the Technical Advisory Committee (TAC), the experiment will be conducted along with the associated modeling to validate the finite element numerical modeling. The models, validated with accelerated pavement test data, can be used to predict damage for the proposed flexible pavement systems. The outcome of the experiment and modeling analysis will be incorporated into a utility that allows analysis of other scalable factors to be applied to outcomes in terms of predicted pavement damage, traffic accidents, environmental and economic factors.

The utility should allow the states to determine how their current Truck Size and Weight regulations influence the overall benefit ratio to allow decisions to be made in terms of their preference and to analyze alternative scenarios.

Communications

- Arrangements for teleconferences, web conferences and face to face meetings of the Technical Advisory Committee, including travel, lodging and per diem. Face to face meetings will be limited to a maximum of 1 per annum, with web and teleconferences conducted on demand.
- Preparation of articles for periodicals such as *Public Roads*, *Transportation Research Record* and *FOCUS*.
- Presentations to relevant conferences and symposiums, such as Transportation Research Board.

Deliverables

- Literature Synthesis and Experimental and Analysis Plan 60 days following contract award.
- Quarterly reports due on the weekday closest to the 15th of the month following the quarterly period of performance.
- Draft Final Report delivered 20 months from contract award date. The draft final report will include documentation of all relevant physical materials, equipment, instrumentation, experimental, analysis, modeling, computer code and user aids. A 30 day technical review will follow.
- Draft Executable Utility and manual with guidelines for its use by states to evaluate the use of wide base tires with regard to impacts on pavement networks, environmental and economic factors (including documented source code). A 30 day technical review will follow.
- 2nd Draft Final Report delivered 30 days following feedback from the technical review. All data generated during the project in a well documented and organized format in both MS Excel and CSV format.
- 2nd Draft Executable Utility and manual with guidelines delivered 30 days following feedback from the technical review.
- Final Report and Utility delivered 30 days following an editorial review with corrections.

Period of Performance

The period of performance shall consist of a 24 month base period plus a 12 month option year. The base period will include 1 month for TAC review of the Literature Synthesis and Experimental and Analysis Plan and 6 weeks for TAC review of the draft final report and associated deliverables.