FY 2011 Research Problem Statement

ODOT Research Section
200 Hawthorne Ave. SE
Suite B-240
Salem OR 97301-5192

Phone (503) 986-2700
Fax (503) 986-2844

I. TITLE

12-074 Coefficient of Friction of Rubber Tires on Streetcar Tracks under Dry and Wet Conditions

II. PROBLEM

Metropolitan areas nationwide are pursuing land use goals of denser, mixed-use development projects. Along with these projects, a trend of streetcar projects to serve the short commute needs of people living in these urban renewal districts. City of Portland is currently constructing streetcar tracks on ODOT's structures and proposing to place streetcars tracks on OR43. Recent discovery among Highway Division staff found no research nationally or internationally identifying a wet or dry coefficient of friction of rubber tires on streetcar tracks.

Risk Management recommends the Highway Division to run rubber tire skid resistance tests on streetcar tracks to determine whether any mitigation is needed to increase the coefficient of friction of the tracks and/or the area surrounding the tracks. If the tracks have a low coefficient of friction, the Highway Division has the following safety concerns:

1. A car with the same track width as streetcar tracks skidding on the steel tracks especially in wet conditions; and
2. A car rotating due to braking with one tire on the track and the other tire on the concrete.

In 2002, Justice Holland in England ruled that the 4mm to 10mm ridge formed by the tram rail protruding above the surface contravened the 1870 Tramways Act, which requires rails to be flush with the road surface. Failure to achieve this led to a vehicle crash. Portland's streetcar steel rail protrudes a quarter of an inch (6.35mm) above the surface.

The width from the outer steel sides of the streetcar tracks is 59.5 inches. 1.625 inches of steel on these outer ends are raised a quarter of an inch above the concrete. Popular cars have similar track widths as streetcar: Honda Civic Sedan (59.0 inches), Toyota Corolla (59.8 inches), Ford Focus Sedan (58.6 inches), Nissan Sentra (59.8 inches), and Chevrolet Cobalt Sedan (58.7 inches).

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

Measure the drag factor of vehicles on streetcar tracks and on concrete surrounding the tracks under dry and wet conditions. Use the mean consistent drag factor test runs to derive the coefficient of friction. The tests will need to be performed with vehicles that have similar track width as the streetcar tracks and under the following conditions:

- Tires on Dry Streetcar Tracks
- Tires on Dry Concrete Surrounding Streetcar Tracks
- Tires on Wet Streetcar Tracks
- Tires on Wet Concrete Surrounding Streetcar Tracks

A minimum of three test runs for each surface. If the tests do not fall within a tolerance of +/- 5%, additional test runs will be conducted. A video camera will be used to monitor the tires on the surface for each test run. More than one test vehicle may be used.

The resultant drag factors will be adjusted for grade to determine the coefficient of friction. Grade will be measured in the field using an electronic level. Vertical profile from previous streetcar plans will be used as a reference.

The VC2000 and/or VC3000 are some devices to measure the drag factor.
http://www.vericomcomputers.com/VC3000Models.html

IV. POTENTIAL BENEFITS

The results of the tests will inform ODOT and its partners the coefficient of friction of rubber tires on streetcar tracks. Based on this information, ODOT and its partners can determine if any mitigation is needed on highway or tracks to enhance the coefficient of friction. The tests also show that ODOT did their due diligence investigating the coefficient of friction of streetcar tracks.

V. IMPLEMENTATION

The product of the research will be a technical memorandum or research paper listing the results of the skid resistance tests. The memorandum will not conclude whether the streetcar tracks are safe or unsafe in regards to skid resistance. It will produce information that can be used to further inform our engineering efforts.

VI. LIST OF REFERENCES *(optional)*

Steve Espinal of California Public Utilities Commission and Larry Moore of CALTRANS do not recommend placing streetcar tracks in shared travel lane as cars on highways with posted speeds higher than 25 miles per hour. According to Larry Moore, CALTRANS is in the process of revising their design manual with a draft guidance of allowing streetcar tracks to share mixed flow lanes when the speeds are 25 miles per hour or less.

Senior Trooper Jeffrey C. Willis from the Oregon State Police is a good resource on the VC2000 and VC3000 devices. He has taken the Emergency Vehicle Operator Course (EVOC) and has a history of running the vehicles without ABS to measure the roadway skid resistance under crash investigations.

2001 – 2009 crash data and 2005 – 2009 crash reports obtained from the Crash Analysis & Reporting Unit and the Department of Motor Vehicles on existing Portland streetcar routes show no mention of streetcar tracks contributing to a crash.

VII. CONTACT INFORMATION

Your name: Joseph Auth
Affiliation: ODOT Region 1 Preliminary Design
Telephone: (503)731-8441
Email: joseph.t.auth@odot.state.or.us

Person Responsible for Implementation:
Affiliation:
Telephone:
Email: