FY 2017 Research Problem Statement

ODOT Research Section
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I. TITLE

17-021 Quantifying the Performance of Low-Noise Shoulder Rumble Strips

II. PROBLEM

Roadway departure crashes account for 66% of all highway fatalities in Oregon, the majority of which happen on rural highways (*1*). A number of research-based low-cost countermeasures are available for deployment to reduce roadway departure crashes. Shoulder rumble strips (SRS) are one such low-cost measure, which has been shown to significantly reduce run-off-road (ROR) crashes. The noise and vibration generated by SRS alerts drivers when they are departing the traveled way. Previous research indicates that on rural 2-lane roadways, SRS reduce ROR fatal injury crashes by 33% and all ROR crashes by 15% (*2*). Even though they are inexpensive to install, easy to maintain, and have a very long service life, it is not always possible to install SRS on many roadway segments in Oregon due to factors such as, inadequate shoulder width and the presence of significant bicycle traffic. The rumble strip leaves less room for cyclists to operate, forcing incursions with SRS that are less desirable and forcing cyclists to operate in vehicular lanes. Recently ODOT has received complaints from the residents living adjacent to highways regarding the noise generated by milled-n rumble strips. As a result, SRS are not currently installed on many roadway segments – even where there is documented evidence of ROR crashes.

There is an opportunity to scientifically quantify the noise differentials between traditional and sinusoidal rumble strips (see figure). It is generally believed that sinusoidal rumble strips generate the necessary in vehicle vibration and noise and reduced roadside noise, however, little to no research has been conducted in the US as of yet to accurately quantify them.

Figure 1. Traditional Rumble Strip (left) Sinusoidal Rumble Strip (right)

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

The proposed study will evaluate the feasibility of using sinusoidal SRS as a substitute for traditional SRS on highway segments with ROR crash problems. Sinusoidal SRS will be installed on some highway segments with ROR crash problems (or alternatively at off-highway facility yet to be identified). A noise study will be performed to evaluate how much interior noise and vibration and exterior noise is generated by the SRS alternatives. Noise interior to the vehicle will be measured with a Knowles Electronics Manikin for Acoustics Research (KEMAR) to perfectly reflect the noise perceived by a driver (*3*), and the haptic feedback will be measured with accelerometers mounted on the steering column of the probe vehicle. The roadside noises will be measured at a variety of distances to develop a noise degradation curve. These noises will then be compared with those generated by traditional SRS currently used in Oregon. This comparison will give an indication as to whether sinusoidal SRS can potentially be used as a substitute for traditional SRS in areas with ROR crash problems, but it is not possible to install traditional SRS due to above-mentioned factors. If resources were available and directed by the TAC, bicycle-suitability of the sinusoidal pattern could be tested.

If installed on a highway, a noise survey will be conducted on the residents living adjacent to the sinusoidal SRS test site and a control site with traditional SRS. This survey may provide valuable information regarding the resident's acceptance of this countermeasure in reducing roadway departure crashes.

IV. POTENTIAL BENEFITS

If the research project results confirm that sinusoidal SRS can be used as a substitute for traditional SRS, the research will provide huge benefit to ODOT and other local jurisdictions within the state of Oregon. Highway safety would be improved by reducing roadway departure crashes and the associated fatalities and injuries while nearby residences would not experience as much roadside noise. As these treatments have a high cost-benefit return ratio this improvement would mean possible installation at more sites.

V. IMPLEMENTATION

A successful research project will help ODOT revise its current policies as they relate to roadway departure crashes. Sinusoidal SRS can be added as a low-cost countermeasure in addressing this critical crash type. Guidelines in manuals such as the ODOT Traffic Manual and the ODOT Traffic Line Manual will be modified to reflect the research results as warranted. The Traffic Standard Engineer and Traffic Services Engineer will be responsible for implementing this change.

VI. LIST OF REFERENCES *(optional)*

1. Federal Highway Administration, Oregon Roadway Departure Safety Implementation Plan, U.S. Department of Transportation, May 15, 2010.2.
2. Torbic, D.J., J. Hutton, C. Bokenkroger, K. Bauer, D. Hardwood, D. Gilmore, J. Dunn, J. Ronchetto, E. Donnell, H, Sommer III, P. Gravey, B. Persaud, C. Layton. *NCHRP Report 641: Guidance for the Design and Application of Shoulder and Centerline Rumble Strips*, Transportation Research Board, Washington, D.C., 2009.3.
3. Noyce, D.A. and Dulaski, D. (2006). "Development and Evaluation of Unique Centerline Rumble Strip Pattern to Improve Driver Comprehension," Transportation Research Board 85th Annual Meeting Compendium of Papers, Washington D.C., January 22-26, 2006, 23p.

VII. CONTACT INFORMATION

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