Tire tread depth in car wet-road loss of control

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Prior research1 has suggested the need for an increase in minimum legal passenger car tire tread depth requirements. One of the objections raised to this suggestion is that no data are available to show how important tread depth is in vehicular loss of control.

Some of the significant results of the prior research are shown in Fig. 1. Flat-bed passenger-car tire tests, conducted at Calspan Corp. in 2002, show, for a water-film thickness of 0.05 inches, rapid decreases in available friction at highway speeds for tires with tread depths less than 4/32 inches. A minimum legal tread depth of 2/32 inches (or 1.6 mm in the EU) is nearly universal2.

Objections to increasing the minimum include (1) water depths in the order of 0.05 inches on highway surfaces are rare and (2) there are no data available to indicate that low tread depth is a significant contributing factor to loss of control.

Research to address the first objection has been completed and is expected to be published in 2013. That work indicates that the effects of tire tread depth on wet traction as reported in the prior research1 still persist, for minimally wet surfaces, down to about 0.02 inches of water film thickness.

The second objection to increasing the minimum legal tire tread depth requirement is addressed in this paper.

Method

A total of 7,400 crash reports were reviewed to investigate the contribution of low tread depth to loss of wet traction. The sources of these reports are (1) the National Motor Vehicle Crash Causation Survey3 and (2) Special Crash Investigations4.

Both of these sources are part of the National Automotive Sampling System, an activity of the National Highway and Traffic Safety Administration.

Results

From the total of 7,400 reports, 893 wet-road cases were identified. Of those 893 wet-road cases, 120 had tread depths and pre-crash trajectories suggesting a loss of wet-road traction.

Thus, (893/7,400)100 = 12 percent of the cases studied were wet-road cases and (120/893)100 = 13 percent of those cases were potential loss-of-traction cases.

This suggests that, in the total sample of cases available, (0.12)(0.13)100 = 1.56 percent were potentially wet-road loss-of-control cases.

NHTSA reported5 that “A nationally-representative sample of crashes was investigated from 2005 to 2007,” referring to the NMVCCS investigations.

Using only the data from NMVCCS, there were a total of 6,949 reports which included 822 wet-road cases.

Of those 822 wet-road cases, 109 had tread depths and pre-crash trajectories suggesting a loss of wet-road traction.

Thus, (822/6,949)100 = 12 percent of the NMVCCS cases studied were wet-road cases and (109/822)100 = 13 percent of the wet-road cases suggested loss of wet-road traction.

This suggests that, of 0.12(0.13)100 = 1.56 percent of all the NMVCCS cases potentially involved loss of wet-road traction, the same result as obtained when using all of the data from both sources.

Therefore, if the sample of NMVCCS cases available is considered a representative sample, this factor (1.56 percent) might reasonably be applied to larger data groups.

For example, in the publication NHTSA Traffic Safety Facts 20096 there were reported 23,382 deaths and 1,975,000 injuries in passenger cars and light trucks.

Applying the percentage deduced from the sample studied, one might conclude that there were (1.56/100)(23,382) = ~360 deaths related to loss of wet traction and (1.56/100)(1,975,000) = ~30,800 injuries related to loss of wet traction (Fig. 2).

Policy-makers must decide if these numbers warrant a reconsideration of regulations relating to minimum tread depth for passenger cars.

Tire placement and tread depth

The distribution of the 109 wet-traction loss-of-control cases identified from the NMVCCS data, as a function of average tread depth rear and front, is indicated in Fig. 3.

Each data point in the graph represents a crash.

The red-colored squares indicate cases (39 cases of the 109 total) where the tread difference left-to-right on any one axle was equal to or greater than 2/32 inches.

This fact confounds, somewhat, the analysis of the significance of tire placement from these real-world data.

That is, if the tread data show it to be preferable that the tires with the deepest tread be placed on the rear wheels, which is the generally-accepted advice of tire and vehicle manufacturers?

From Fig. 3a it can be seen that, when the rear tread was equal to or less than 2/32 inches, there were recorded 16 loss-of-control cases, or (16/109)100 = See Tread, page 30
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~15 percent of the total.
When the front tread was equal to or less than 2/32 inches (Fig. 3b), there were recorded six loss-of-control cases, or (6/109)100 = ~6 percent of the total.
Although these numbers are insufficient for statistical analyses, they suggest that low rear tire tread is a more significant safety issue than low front tire tread, on a wet surface.
When the rear tire tread was less than 4/32 inches (Fig. 3c), there were recorded 69 crashes, or (69/109)100 = ~63 percent of the total.
When the front tire tread was less than 4/32 inches (Fig. 3d), there were recorded 46 crashes, or (46/109)100 = ~42 percent of the total. This observation again tends to support the conclusion reached above.
Of course, this is consistent with conclusions based on vehicle handling dynamics—that it is more difficult to recover from oversteer than from understeer.
When the average tread depth of both front and rear tires is greater than 4/32 inches, there are 25 crashes, or (25/109)100 = 23 percent of the total (Fig. 3e).
Stated another way, when the average tread depth on all tires is greater than 4/32 inches, nearly 80 percent of the crashes identified in this study are eliminated.

Conclusions
Based on the sample of crashes considered and the analysis conducted, about 1.56 percent of all cases of loss-of-control studied, likely were related to loss of wet-road traction as a result of low tread depth.
Of the “representative sample” of NMVCCS cases, again about 1.56 percent likely were related to loss of wet-road traction caused by low tread depth.
For the year 2009 this amounts to about 360 deaths and 30,800 injuries likely related to low tread depth, wet-road loss-of-control.
From these real-world loss-of-control data there is some indication that supports the generally accepted conclusion that low tread depth at the rear is more dangerous than low tread depth at the front, on wet surfaces.
The presence of significant tread-depth differences right-to-left, on the same axle, tends to confound the analysis of these real-world data for the purpose of evaluating the importance of tire placement.
Nearly 80 percent of the loss-of-wet-traction crashes identified herein occurred with average tread depths on one or both axles less than 4/32 inches.
It is the hope of the authors that analyses such as those presented herein will assist policy makers when considering recommendations relating to minimum tread depth and tire placement.

Fig. 3b. Front tread equal or less than 2/32 inches.

Fig. 3c. Rear tread equal or less than 4/32.

Fig. 3d. Front tread equal or less than 4/32 inches.

Fig. 3e. Front and rear tread greater than 4/32 inches.

References
5. Persons interested in the identification of the specific cases selected may contact the authors by email at wbinc8831@sbcglobal.net.

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