

Investigation of the Safety Effects of Edge and Centerline Markings on Narrow, Low-Volume Roads

Perspective Because of the increasing number of housing and retail developments, congestion and safety concerns have been raised that some narrow, low-volume roads in Virginia have heavier traffic volumes than they were designed to carry.

Although the installation of edge and/or centerline pavement markings is sometimes used to mitigate such concerns, the Virginia Department of Transportation (VDOT) has specific standards with regard to width and/or traffic volume to warrant such installation and the narrow, low-volume roads in question may not comply with these requirements.

A team from the Virginia Center for Transportation Innovation and Research (VCTIR), VDOT's research division, investigated the safety effects of edge and centerline markings on narrow, low-volume roads in Virginia. As defined in this study, these are two-lane roads 16 to 20 feet wide that carry 3,000 or fewer vehicles per day (vpd). The first objective was to determine if such markings improved safety on these roads.

At the conclusion of an evaluation of crash frequency, density and rate and a safety performance function analysis, the researchers found no statistical difference in traffic safety when comparing roads with and without edge and/or centerline markings.

Despite the lack of statistical significance indicating either a clear positive effect or a clear negative effect, the researchers



Sample road segment with centerline markings only

could not conclude that the presence of markings had no effect on safety. This study compared crashes on various road sections with different markings present as opposed to comparing crashes on the same road after the markings were changed.

The study recommends that VDOT's existing and relatively low thresholds for defining pavements to be marked should continue to guide VDOT traffic engineers. However, the study identifies a possible avenue to pursue that might provide more flexibility and guidance for VDOT traffic engineers in making decisions about which roads to mark.

Background VCTIR's Traffic and Safety Research Advisory Committee recommended this study in response to the following research problem:

Some VDOT residency and regional traffic engineering staff had proposed adding low-cost edge and/or centerline pavement markings on some narrow secondary roads in response to increased traffic volumes. They postulated that the markings would improve safety on narrow roads until such time that higher-cost design improvements, such as widening the road, could be made.

However, VDOT has limited funds for marking pavements, and each new marking requires ongoing maintenance to keep the lines visible. To justify the additional expense of marking roadways beyond those identified by VDOT's pavement marking policy, the benefit of adding the markings needed to be quantified.

Virginia House Joint Resolution (HJR) 243, adopted in 1994, called for VDOT to provide, among other things, centerline markings on all "appropriate" secondary roads having a pavement width of 18 feet or more with a minimum traffic volume of 500 vpd. In response to HJR 243, VDOT changed and clarified its policy with regard to edge and centerline markings.

This new policy was set out in a 1994 VDOT Traffic Engineering Division memorandum (*TE-251: Pavement Marking Policy*). In accordance with TE-251, in general VDOT

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applies edgelines only on primary and secondary routes that do not have curb and gutter, have a minimum width of 20 feet and have a centerline.

Further, edge and/or centerline markings may be installed where an engineering study indicates a need for them. Subdivision streets meeting the edge and centerline criteria are an exception; they are not to be marked unless the street is a through traffic artery.

Research and Recommendations The researchers distributed a questionnaire to traffic engineering staff in all 50 states. The responses received indicated much variation in the practice of other state transportation agencies with regard to installing pavement markings on roads 16 to 20 feet wide.

The researchers used data from VDOT's Highway Traffic Records Information System (HTRIS) to develop a pavement marking inventory and a five-year crash history database for rural two-lane roads with a width of 16 to 20 feet. The researchers supplemented data from HTRIS with visual surveys using Google Earth to determine which segments were marked because consistent pavement marking records were not available.

They identified approximately 2,000 miles of secondary and primary two-lane, undivided roads and classified them by width (16, 18 and 20 feet), traffic volume range (1-500 vpd or 501-3,000 vpd) and four conditions of pavement markings: (1) having both edge and centerline markings; (2) having centerline markings only; (3) having edgeline markings only; and (4) having no markings.

The researchers performed a comparative crash analysis that studied the effects of many different variables to see if the examined narrow roads with pavement markings were safer than those without pavement markings.

They used analysis of variance modeling on the safety measures of five-year crash frequency (number of crashes/5 years), crash density (number of crashes/mile/5 years) and crash rate (number of crashes/mile/vehicle/5 years). In addition, they developed a safety performance function to examine the safety effect of each pavement marking condition.

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After evaluating all four approaches, they found no statistical difference in the effects on safety between the roads studied, whether with or without pavement markings. Larger sample sizes would have been beneficial to allow a better comparison of differences, but because of the limited number of narrow, low-volume road segments and the limited crash history for these roads, sample sizes were small.



Sample road segment without pavement markings

The study recommends that VDOT's Traffic Engineering Division consider developing a statewide process for inventorying pavement marking in partnership with VDOT regional operations staff.

The study also recommends that the division consider asking the Office of the Attorney General of Virginia for an interpretation/opinion of the term "appropriate" in HJR 243. Further, if such an interpretation were to conclude that VDOT may offer guidance to determine what narrow, low-volume secondary roads are appropriate for pavement markings, the division should consider pursuing the development of such guidance.

The study suggests that such guidance be flexible and include principles based on experience to allow VDOT traffic engineers to consider factors such as the type of road users, crash history and road geometry (especially the presence of curves) when determining the need for pavement markings.

The Virginia Center for Transportation Innovation and Research (VCTIR) is proud to contribute to VDOT's reputation as a national transportation leader. VCTIR greatly appreciates the cooperation and support of VDOT and the Federal Highway Administration.