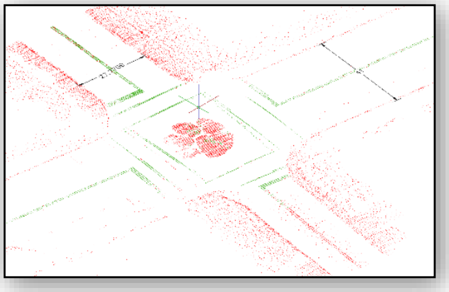

Operational and Safety Characteristics of Lane Widths

Executive Summary

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Dr. Jennifer H. Ogle and Dr. Wayne A. Sarasua, Clemson University
Dr. William J. Davis, The Citadel

The current 2003 South Carolina Highway Design Guide allows little leeway on lane widths for new projects, with 12’ representing the typical design value for travelway widths and 15’ for two-way left-turn lanes (TWLTL). There is debate on whether or not using a fixed lane width in different contextual settings is ideal, both from safety and economic standpoints as well as whether it is beneficial to traffic operations. Due to increased project costs and the need to provide context sensitive solutions, the South Carolina Department of Transportation sought to evaluate the SCDOT design standards for travel lane widths and auxiliary lane widths for the purpose of determining the safety and operational effects of adjusting these widths. SPR 693, “Operational and Safety Characteristics of Lane Widths,” was initiated with Clemson University. Because of the many site conditions that affect safety and operations on roadways, this type of research is critical to the development of appropriate road design standards.

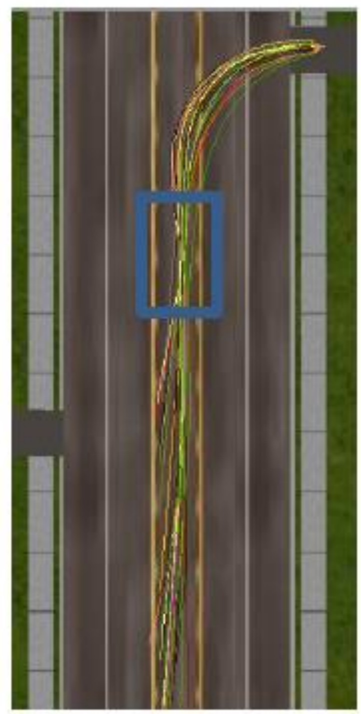
The research was conducted in two phases:

- Phase A – A field study using mobile laser and video technologies to collect data for 1,292 sites (i.e., dimensional data, roadside characteristics, speed limits, and contextual setting) which were combined with crash history and traffic volumes to conduct a comparative cross-sectional analysis evaluating the effect of travel lane dimensions on safety and operations; and
- Phase B – A follow-on driving simulator test of travel lane management treatments (i.e., redistribution of lane width and shoulder width, changes in curve radii and clear zone, and operational effects of smaller TWLTL) where either examples did not exist in the field, or where sample sizes were of insufficient size.

In Phase A, the data-driven research methodology correlated lane widths on a variety of roads of varying characteristics with 3 years of crash data to develop models describing the effect of lane width on crashes. The success of this analysis was, in many ways, dependent on the variety and consistency of roadway characteristics in South Carolina. Modeling limitations were encountered because the majority of sites had lane widths of 12’ – a level of design consistency that made comparative modeling difficult. However, the consistency of the 12’ lane width is a testament to the conformity with the SCDOT design policy that has been in place for many years. Regardless, results from several models were obtained (rural two-lane undivided, rural four-lane divided, urban two-lane undivided, urban two-lane with TWLTL, and urban four-lane with TWLTL) corroborating results of prior studies. Narrower widths on rural roads tended to increase crash rates, particularly on roads with large traffic volumes and high speeds. Urban roadways did not indicate significant relationships with changes in lane width; however, driveway density was significant and increased density related to increased crashes. Further, urban four-lane with TWLTL configurations were found to have the least crashes when shoulders and curb/gutter were present. Some surprising findings were uncovered with respect to low-speed low-volume roadways; which indicated that narrow lanes (10’) experienced decreased crashes. Thus, these roadways need not be increased, and could continue to be used in limited circumstances.

Some of the most interesting results from the study came from the Phase B simulator study. Phase B had three distinct tests: 1) number and extent of roadside encroachments for various lane width/shoulder width combinations, 2) number of encroachments on small, medium, and large curve radii curves to left and right; and 3) gap acceptance/delay and extent of erratic maneuvers into TWLTLs. The results are summarized below for each test:

1. Measurements for the percent time out of lane and number of out of lane encroachments were evaluated for three lane and shoulder width combinations (a 12' lane/no shoulder, a 12' lane/2' paved shoulder, and a 10' lane/2' paved shoulder). The 12/no shldr had 6 encroachments, the 12'/2' shldr had 13 encroachments, and the 10'/2' shldr had 28 encroachments. Reducing lane width and adding a shoulder increased encroachments, but all encroachments remained on the shoulder area. The 12'/no shldr scenario had the left-most lane position and all encroachments were considered severe – especially in the presence of oncoming traffic or pavement edge drop-offs. While flexible lane widths were recommended, 2' shoulders were strongly suggested on narrower widths.
2. All of the curve radii in the three scenarios were split into three categories of small (900'-1200'), medium (1201'-1500') and large (1500'-5500'). Based on these ranges and the radii of the curves given in the scenarios, roughly half of the curve encroachments were experienced on the small radii curves. Curves to the left were also more involved in encroachments than curves to the right. To combat the effect of curves, curve widening and increased clear zones in curve sections (particularly on curves to the left) can be used to mitigate issues associated with the use of narrower lanes.
3. TWLTL simulator scenarios included both three-lane and five-lane road cross section configurations and TWLTL widths of 12, 14 and 16 ft. Statistical tests indicated that TWLTL widths of 12, 14 and 16 ft. had no effect upon gap acceptance for three-lane and five-lane roadway sections. Trajectories were compared for a random sample of participants to evaluate the effect TWLTL widths had on vehicle encroachments into through lanes. Very few encroachments into the travel lane were noted during maneuvers; however, greater variation in lane position was observed for larger TWLTL widths as participants took advantage of the larger space for maneuvering. Narrower TLWTLs can and should be adopted.



A (12 ft.)

The results of this research should have significant benefits for SCDOT and users of the state's highways. These benefits fall into several categories. The benefits are related to safety, operations, and potential cost savings to SCDOT. Proposed revisions to the lane width design criteria specified in the SCDOT Highway Design Manual reflect more flexibility in line with the 2011 AASHTO policy. The revisions will benefit several SCDOT units including Preconstruction, Construction, Traffic Engineering, and Maintenance. Flexibility helps designers by allowing them to make decisions appropriate to setting and environment. The economic benefits will provide support for design decisions that could potentially reduce project impacts, resulting in reduced costs. In addition, a reduction in maintenance costs would be achieved when resurfacing or rehabilitating a route due to the reduced pavement width required. In some cases a reduction in travel lane width may correspond to an increase in shoulder width. Overall, more flexible design standards should lead to more sustainable facilities – especially those roadways with low volumes, low speeds, and limited crash experience.