



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 18, 2008

In reply refer to: H-08-3 through -7

The Honorable James Ray
Acting Administrator
Federal Highway Administration
1200 New Jersey Avenue, S.E.
Washington, D.C. 20590

About 5:38 a.m. eastern standard time on Friday, March 2, 2007, a 2000 VanHool T2145 57-passenger motorcoach operated by Executive Coach Luxury Travel, Inc., transporting 33 members of the Bluffton University baseball team, the driver, and his wife, was traveling south on Interstate 75 (I-75) in Atlanta, Georgia.¹ The motorcoach had departed from the university, about 60 miles southwest of Toledo, Ohio, about 7:00 p.m. the previous day and was en route to a competition in Sarasota, Florida. When the original driver had stopped in Adairsville, Georgia, approximately halfway through the 18-hour trip, the 65-year-old relief driver, accompanied by his wife, boarded the motorcoach and began driving at 4:30 a.m. to complete the trip to Florida. The relief driver had driven approximately 54 miles and, according to witnesses, was in the southbound high occupancy vehicle (HOV) lane at milepost 250 when the motorcoach departed the interstate, traveling at highway speed, onto the HOV-only left exit ramp to Northside Drive.

The exit ramp came to an end at the stop sign-controlled T-intersection with Northside Drive. As the motorcoach entered the intersection at an estimated speed of 50 to 60 mph, the driver steered to the right and collided with the reinforced portland cement concrete bridge wall and chain-link security fence located along the southern edge of the eastbound lanes of the overpass. The motorcoach then overrode the bridge rail, rotated clockwise, and fell 19 feet onto the southbound lanes of the interstate. The motorcoach came to rest on its left side (driver's side), perpendicular to the southbound lanes of I-75. Two southbound passenger vehicles received minor damage from debris as the motorcoach fell onto I-75; none of the passenger vehicle occupants were injured. Seven motorcoach occupants were killed: the driver, the driver's wife, and five passengers. Seven other passengers received serious injuries, and 21 passengers received minor injuries.

¹ For more information, see *Motorcoach Override of Elevated Exit Ramp, Interstate 75, Atlanta, Georgia, March 2, 2007*, Highway Accident Report NTSB/HAR-08/01 (Washington, DC: NTSB, 2008), which is available on the National Transportation Safety Board's website at <<http://www.nts.gov/publictn/2008/HAR0801.pdf>>.

The National Transportation Safety Board determined that the probable cause of this accident was the motorcoach driver's mistaking the HOV-only left exit ramp to Northside Drive for the southbound Interstate 75 HOV through lane. Contributing to the accident driver's route mistake was the failure of the Georgia Department of Transportation (GDOT) to install adequate traffic control devices to identify the separation and divergence of the Northside Drive HOV-only left exit ramp from the southbound Interstate 75 HOV through lane. Contributing to the severity of the accident was the motorcoach's lack of an adequate occupant protection system.

The primary issue under investigation in this accident was the adequacy of the highway signage and roadway markings to reliably alert drivers of the HOV-only left exit ramp and to provide route guidance for interstate through traffic. In this accident, the driver inadvertently and unknowingly exited the interstate; and, once on the HOV-only left exit ramp, he received insufficient cues to alert him that he was no longer on the interstate. By the time the driver realized the route mistake, he had insufficient time to stop the motorcoach at the Northside Drive intersection.

In the weeks following the accident, other drivers who had experienced problems navigating the I-75 HOV-only left exit ramp at the accident location contacted Safety Board investigators. One, a professional motorcoach driver, had mistakenly taken the exit ramp and run the stop sign on Northside Drive at the top of the ramp but was able to negotiate a right turn and stop the motorcoach. He explained that he had unintentionally followed the solid yellow edge line on the left up the exit ramp.

Upon entering the Atlanta metropolitan area southbound on I-75, drivers encounter the first HOV-only left exit, Northside Drive. One mile past the Northside Drive HOV exit, the merge of I-75 with Interstate 85 (I-85) is constructed such that the southbound I-75 HOV lane diverges to the left, separating from the general purpose travel lanes, and curves around to connect with the southbound I-85 HOV traffic lane much like an exit ramp. This merge of the HOV lanes and the general purpose traffic lanes is handled separately. The accident driver intended to take I-75 and merge with I-85 to continue south. The I-75 HOV route for that merge diverged from the HOV lane to the left at an angle similar to the Northside Drive left HOV exit.

Left interstate exits are an uncommon road design. GDOT records identified several similar accidents that had occurred at this location that should have alerted GDOT to the need for additional driver guidance. Seven of the nine accidents documented by GDOT in the accident vicinity involved drivers who had taken the exit ramp at interstate speeds and failed to stop at the intersection. Following fatal accidents in 2001 and 2002, GDOT conducted a review of the intersection traffic control devices at Northside Drive. The Northside Drive intersection did not meet the accident experience criteria or other *Manual on Uniform Traffic Control Devices* (MUTCD) warrants and, therefore, signals were not installed. GDOT's postaccident safety evaluations did not consider whether remediating traffic control devices were needed before the required stop. Consequently, the Safety Board concludes that GDOT failed to identify the Northside Drive HOV-only left exit, which was in a left curve preceding a high-speed left interstate merge, as an unexpected arrangement that required additional traffic control devices to guide road users.

The signage arrangement at the Northside Drive exit exacerbated the accident driver's navigational problems. The original signage plan for I-75 included a pull-through sign mounted adjacent to the exit sign. But, according to GDOT, the pull-through sign was installed 0.2 mile north of the Howell Mill Road overpass (so that the southbound accident driver encountered it earlier than the exit sign) because of installation problems with the dual cantilevered structure. An alternative to the cantilevered sign structure would have been a full overhead (Type V) sign structure capable of holding both the exit sign and the interstate pull-through sign. GDOT did not use that solution, however, stating that the addition of a pull-through sign would have limited the sight distance for the signs mounted on the Northside Drive overpass. The overpass signage consists of two periodically recurring HOV-lane use message signs (*BUSES/CARPOOLS ONLY*) and an advance route guide sign for three general purpose traffic exits that occur after the upcoming interstate merge in 1.25 miles. A sight distance of more than 1,120 feet (the length of the exit ramp) is more than adequate for these general signs, and, in fact, is a greater sight distance than that afforded users of the Northside Drive exit sign (based on a sight distance of 875 feet).

Guidance provided by the Federal Highway Administration (FHWA) to its Division Administrators after the accident² states that the pull-through sign is of particular importance when the direct exit could be mistaken for a preferential lane that continues, as occurs on curved alignments or where other physical roadway features, such as an overpass, make it difficult to discern the exit geometry from the approach. Positioning the exit sign to the left of the pull-through sign in a side-by-side configuration would have alerted road users of the lane positions; separated, the pull-through and exit signs lost their spatial relationship. Further, removing the pull-through sign from the location where the original design plans called for it to be mounted also removed it from the decision point on the highway where it was most needed. Moreover, the information on the Northside Drive overpass signs that GDOT was concerned about obscuring was not critical to immediate route guidance. The Safety Board therefore concludes that GDOT, in changing the original design plan by separating the Northside Drive HOV exit sign from the I-75 South pull-through sign, caused the effective meaning of the paired signs to be lost at a critical decision point on the highway. The Safety Board also concludes that positioning the Northside Drive HOV-only left exit direction sign next to the I-75 South pull-through sign will promote positive guidance to motorists on the appropriate travel lanes at a critical decision point on the highway.

The southbound I-75 HOV lane starts at the Interstate 285 beltway approximately 7 miles north of the Northside Drive exit. Along that route, the accident driver would have encountered 48 HOV diamond pavement markers and experienced 34 HOV diamonds on median-mounted or overhead signs. The Northside Drive exit ramp also displayed an HOV diamond pavement marking just past the exit gore, and the exit gore sign displayed an HOV diamond with an arrow. The exit ramp design at Northside Drive was unconventional and problematic, most notably because it was the first left exit along the route and, as such, was unexpected. The Safety Board therefore concludes that, because of the unique combination of geometric features and lane restrictions of an HOV-only left exit, redesigning the Northside Drive exit signs to include a message plaque with the legend *LEFT* in black on a yellow background placed at the top left

² FHWA information memorandum on traffic control devices for preferential lane facilities, Associate Director for Operations, August 3, 2007.

edge of the *1 MILE* and *1/2 MILE* guide signs will better alert drivers to the unconventional exit design. The Safety Board therefore has recommended that GDOT install a *LEFT* message plaque on the *1 MILE* and the *1/2 MILE* advance exit guide signs and on the directional arrow exit sign for Northside Drive and position the pull-through sign for the southbound I-75 HOV through lane so that it is next to the Northside Drive left-exit direction sign. To ensure that other left exits are readily recognized by motorists, the Safety Board has also recommended that GDOT install exit signs with *LEFT* message plaques for left interstate exits. The Safety Board has further recommended that GDOT install pull-through signs next to the exit direction (arrow) signs to ensure positive route guidance at exits with limited sight distance, short ramps, or multiple route choices. To ensure that these signage conventions are applied consistently throughout the Nation's interstate highway system, the Safety Board also believes that the FHWA should include in an MUTCD standard the requirements for HOV-only left exits to have *LEFT* message plaques on all exit guide signs and for exit direction (arrow) signs to be positioned next to pull-through signs at exits with limited sight distance, short ramps, or multiple route choices.

In addition, the Northside Drive exit ramp had no advisory speed sign (MUTCD W13-2) to advise the driver of a slower speed despite the ramp's relatively short length of 1,120 feet. Such signage would seem particularly relevant along a route where, based on the postaccident speed study, traffic exceeds the posted speed limit. A sign advising motorists of a lower exit ramp speed offers yet another opportunity to assist drivers in safely navigating the elevated ramp, particularly at night when sight distances are restricted. The Safety Board could not reliably determine whether the motorcoach headlamps were on high or low beam, but it is likely that the accident driver, like many travelers in urban traffic, would have been traveling with low-beam illumination. On a lighted roadway under those conditions, a vehicle's headlights would illuminate the elevated roadway, but only after some distance up the ramp would they illuminate the *STOP AHEAD* pavement markings or the *STOP* sign, at which point, the accident motorcoach was within a few hundred feet of the intersection and still traveling at highway speeds (50 to 60 mph). This situation afforded the driver only 1 to 2 seconds to perceive the sign message, understand its meaning, make a decision, and execute that decision. According to the MUTCD, this reaction time can vary from several seconds for general warning signs to 6 seconds or more for warning signs requiring a high degree of road user judgment. A reduced speed advisory sign early in the exit ramp would have indicated a different traffic situation to the driver and, if he had slowed, would have afforded him more time to process the stop sign information and execute a stop. The Safety Board concludes that because the Northside Drive exit ramp is short and terminates at a nonsignalized intersection, an advisory ramp speed sign is needed for motorist safety. The Safety Board has recommended that GDOT install an advisory speed limit sign (MUTCD W13-2) on the Northside Drive HOV exit ramp and on interstate left exit ramps throughout the State. The FHWA's recent notice of proposed amendments (NPA)³ also addresses advisory exit speed signs, proposing in the section titled "Advisory Exit and Ramp Speed Signs" to revise the MUTCD standard to require the use of advisory speed limit signs on interstate ramps. The Safety Board agrees with the proposal and believes that the FHWA should include in an MUTCD standard criteria for the use of advisory speed limit signs for all interstate exit ramps.

³ "National Standards for Traffic Control Devices; the *Manual on Uniform Traffic Control Devices for Streets and Highways*; Revision," *Federal Register*, Vol. 73, No. 1 (January 2, 2008).

The driver's intended route of travel was the southbound I-75 HOV lane and, given his speed of 50 to 60 mph, it is apparent that his movement to the exit ramp was a mistake. Because the driver likely did not realize that the motorcoach was on the exit ramp, he also did not realize the need to stop at the top of the ramp. His first visual cue for the ramp was the dashed white edge line separating the ramp from the HOV lane. A reliance on the yellow edge line that had guided him through the long and gradual left curve of I-75 may have diminished his awareness of the dashed white line and also have contributed to his missing the barrier-mounted *EXIT* sign on the right in the gore area. Since the accident, GDOT has changed the dashed white line to a dashed yellow line; however, no MUTCD standard provides for the use of a dashed yellow line to delineate left exits. The MUTCD's standard notes that yellow longitudinal markings delineate the separation of traffic traveling in opposite directions, the left edge of divided roadways, and the separation of two-way left turn lanes. The FHWA's information memorandum regarding traffic control devices for preferential lane control sent after the accident recommended that a dashed white guide line marking be used to separate an exit lane from a continuing through preferential lane; the guidance did not specifically address left exits.

Because yellow lines mark the left edge of divided roadways, and because dashed lines indicate an option for traffic crossing, GDOT used a yellow dashed line for postaccident marking on the Northside Drive exit ramp divergence from the interstate through lane. Although there is not specific guidance for that action, GDOT's efforts to more positively mark the exit ramp merit consideration. If the driver were using the yellow edge line as his primary lane tracking cue, he might have been more likely to notice the dashed yellow marking delineating the exit. The Safety Board concludes that the use of yellow dashed lines for left exit pavement markings and white dashed lines for right exit pavement markings should be considered to emphasize and distinguish left exits. The Safety Board therefore believes that the FHWA should evaluate the MUTCD standard for guide line marking requirements for interstate left exits.

Both the exit ramp and the I-75 HOV through lane contain an HOV diamond roadway pavement marking just past the start of the exit. The driver would have experienced a regular display of these HOV diamond pavement markings along his interstate route, and the exit ramp diamond pavement markings appeared identical to the I-75 HOV through lane markings. Further, the exit lane did not have an *EXIT* pavement marking. After the accident, GDOT added an *EXIT* pavement marking to the Northside Drive exit ramp's diamond pavement marking. The Safety Board agrees that this modification enhances the lane markings and helps to ensure that motorists realize they are exiting the interstate. The Safety Board concludes that pairing an *EXIT* pavement marking with the HOV diamond pavement marking is a useful traffic control enhancement for all left HOV exits. The Safety Board therefore has recommended that GDOT add an *EXIT* pavement marking paired with the HOV diamond pavement marking at all left HOV interstate exits.

This accident also illustrates the importance of HOV traffic control devices being sufficiently similar, regardless of their geographic location, to create consistent expectations related to common geometric, operational, and route characteristics. Route guidance signs for HOV motorists traveling on I-75 South used the regulatory sign color convention of a black legend on a white background. Although this convention is appropriate to communicate the HOV information for preferential lane use (buses and two-person carpools), motorists are accustomed to looking for a sign with a white legend on a green background for route guidance. Current managed lane facilities are split between those that use green guide signs and those that favor

regulatory signs with white as their primary background color.⁴ The Safety Board understands that developing a national consistency of terminology, color, and symbology for managed lanes is the FHWA's number one priority on its 2007 prioritized research list and agrees that this issue should be a priority. Consistency is the main factor in driver expectation, and driver expectancies for traffic control devices are based on previous experience of similar traffic situations.

In 2003, your agency committed to an MUTCD update cycle of 5 years, indicating that the next edition will be released in 2008. The comment period for the MUTCD NPA closed on July 31, 2008. The Safety Board believes that the FHWA should work with the National Committee on Uniform Traffic Control Devices to ensure that the next edition of the MUTCD is issued as scheduled in 2008 and that the revision comprehensively addresses the uniformity of HOV traffic control devices, including left exits.

In the MUTCD NPA, you are proposing a standard to require black-on-yellow *LEFT* message plaques for left exits and advance guide signs, with a phase-in period of 10 years for existing signs. Although 10 years is a common phase-in compliance period for new sign requirements, because the message plaques would be added to the top left edge of existing left exit signs and, in most cases, would not involve replacing existing signs in good condition, the Safety Board concludes as a result of the Atlanta accident investigation that the supplemental *LEFT* message plaques should be phased in sooner than the typical 10-year MUTCD compliance timeframe. Therefore, the Safety Board believes that the FHWA should require a phase-in period of 5 years for supplemental *LEFT* message plaques in the standard proposed for the next edition of the MUTCD.

As a result of its investigation, the National Transportation Safety Board makes the following recommendations to the Federal Highway Administration:

Include in a *Manual on Uniform Traffic Control Devices* standard the requirements for HOV-only left exits to have *LEFT* message plaques on all exit guide signs and for exit direction (arrow) signs to be positioned next to pull-through signs at exits with limited sight distance, short ramps, or multiple route choices. (H-08-3)

Include in a *Manual on Uniform Traffic Control Devices* standard criteria for the use of advisory speed limit signs for all interstate exit ramps. (H-08-4)

Evaluate the *Manual on Uniform Traffic Control Devices* standard for guide line marking requirements for interstate left exits. (H-08-5)

Work with the National Committee on Uniform Traffic Control Devices to ensure that the next edition of the *Manual on Uniform Traffic Control Devices* is issued as scheduled in 2008 and that the revision comprehensively addresses the uniformity of HOV traffic control devices, including left exits. (H-08-6)

⁴ S. Chrysler and B. Kuhn, *Traveler Information and Traffic Control Devices for Managed Lanes* (College Station, Texas: Texas Transportation Institute, April 2007).

Require a phase-in period of 5 years for supplemental *LEFT* message plaques in the standard proposed for the next edition of the *Manual on Uniform Traffic Control Devices*. (H-08-7)

The Safety Board also issued five new recommendations to the Georgia Department of Transportation and reiterated four previously issued recommendations to the National Highway Traffic Safety Administration.

In response to the recommendations in this letter, please refer to Safety Recommendations H-08-3 through -7. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred in these recommendations. (At the time that the safety recommendations were adopted, Mark V. Rosenker was Chairman.) Member HERSMAN filed a concurring statement, which is attached to the highway accident report.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman