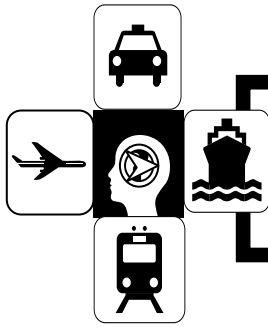


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## Tech Brief

### Safety Audit of Fatalities and Injuries Involving Guide Rail

FHWA-NJ-2007-001

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#### Summary

Guide rail are designed to protect vehicle occupants from trees, poles and other hazards they may encounter in run-off road accidents. Unfortunately, a guide rail is not always a forgiving object to strike. In 2005, there were 1189 fatal crashes and 35,000 injurious crashes into guide rail in the United States [NHTSA, 2006].



#### Collisions with Guide Rail are not always forgiving

The goal of this study was to evaluate fatal and injury-causing guide rail accidents in New Jersey. Guide rail crashes in New Jersey were characterized by available crash data as well as in-depth crash investigations. Although guide rail were found to exhibit admirable crash performance in most cases, there remain several unresolved issues identified through this research. These include (1) secondary collisions, (2) the potential for rollover, (3) motorcycle-to-barrier crashes, and (4) side impacts.

## **Introduction**

Guide rail are designed to protect vehicle occupants from and other hazards they may encounter in run-off road accidents. Unfortunately, a guide rail is not always a forgiving object to strike.



**W-Beam Guide Rail Installed along Interstate 295**

The reasons why guide rail impacts sometimes lead to fatality or injury are complex and not completely understood. Guide rail problems include, but are not limited to, many of the following issues (1) improper installation, (2) impacts with end treatments, (3) unfavorable roadside conditions, e.g. soft soil or excessive side slope (4) side impact, (5) improper redirection after a crash, (6) wheel snagging, and (7) secondary impacts with fixed objects. Guide rail performance can be affected not only by barrier design, but also by vehicle design. Poor guide rail performance may result from (1) light trucks overturning on impact with guide rail, (2) cars “submarining” under the rail, (3) airbag-induced injuries, and (4) incompatibility with heavy trucks.

## **Research Approach**

Rowan University and Virginia Tech has been contracted by the New Jersey Department of Transportation to study guide rail collisions in New Jersey. The objective of this project was to investigate the factors which can result in injury to occupants of a vehicle involved in a crash with a guide rail and to recommend actions for improvements in guide rail safety performance. To accomplish this objective, the research team (1) assembled previous and ongoing research on fatal and injurious guide rail impacts, (2) evaluated fatal and injury-causing NJ guide rail crashes through available state crash data and in-depth guide rail crash investigations, and (3) determined unsolved guide rail collision problems.

## FINDINGS

**NJ Guide Rail Crashes.** Based on New Jersey Crash Records from 2003-2005 and the Fatality Analysis Reporting System (FARS) 2000-2005, following is a summary of the characteristics of guide rail collisions in New Jersey:

1. Each year in New Jersey, approximately 10,000 vehicle occupants are exposed to crashes involving a guide rail impact. In crashes in which the guide rail was the most harmful object struck approximately 10-12 persons were fatally injured and 100 persons received incapacitating injuries. Approximately 40 fatal crashes involved a guide rail impact of some nature.
2. In general, guide rail in New Jersey perform well in crashes. Guide rail crashes fortunately result in only a small fraction (1.5%) of New Jersey highway deaths. Three-fourths of all occupants exposed to guide rail crashes suffer no injuries.
3. State highways are overrepresented in serious guide rail collisions. State highways account for 23% of all guide rail crashes, but 30% of all fatal and incapacitating guide rail crashes.
4. The State of New Jersey does not have an unusually high percentage of guide rail fatalities. New Jersey ranks only 20th among the states in terms of guide rail fatalities as a percentage of all traffic fatalities

**In-Depth NJ Guide Rail Crash Investigations.** The research team performed in-depth investigations for 26 NJ guide rail crashes and cursory investigations for an additional 25 NJ guide rail crashes. In-depth investigations consisted of photographs and detailed field measurements of damaged barrier components and roadside conditions such as barrier offset and shoulder width. Cursory investigations were performed at less accessible sites and consisted only of photographic information.



**W-Beam Barrier on Interstate 295 Damaged by a Tractor Trailer**

Based on the field investigations of guide rail crashes in New Jersey, guide rails are found to be performing adequately. Occupant injury is typically minor, if any, unless the vehicle subsequently rolls over. Secondary crashes were found to be a problem; forty percent of investigated crashes involved another impact after a guide rail strike.

**Identified Problems with Guide Rail Crash Performance.** Although guide rail exhibit admirable crash performance, there remain several unresolved issues in guide rail crash safety. Each issue is summarized below:

1. Secondary Impacts. Over half of all fatal guide rail collisions involved a secondary event – either a second impact or a rollover. Many of these secondary events, e.g. trees, poles, and rollovers, typically carry a much higher fatality risk than a guide rail impact.
2. Guide Rail as a Potential Rollover Hazard. In New Jersey, 14% of all fatal guide rail collisions result in a rollover. Although all vehicles can overturn, light trucks having a high center of gravity may be especially at risk. When light trucks collide with guide rail there is a significantly greater chance of guide rail “vaulting” and roll-over.
3. Motorcycles. Motorcycle riders account for over one-fourth of all New Jersey guide rail crash fatalities – a surprisingly high fraction. Nationally, motorcycle riders now account for more fatalities than the passengers of any other vehicle type involved in a guide rail collision.
4. Side Impacts. Frontal impacts are the most common type of guide rail impact, but side impacts are the most lethal crash mode. Side impacts are only 16% of all crashes, but result in 27% of all fatal guide rail crashes. Particularly dangerous are side impacts into guide rail end treatments.

## **Conclusions**

Based on analysis of fatal and injury-producing guide rail crashes in New Jersey, guide rail was found to be performing well in most cases. Guide rail crashes result in less than 2 percent of New Jersey highway deaths. Despite this exemplary performance, there were several unresolved guide rail crash performance issues identified through this research. Specific problem areas include secondary collisions, the tendency of light trucks to “vault” or rollover, motorcycle impacts, and crashes where the vehicle side structure engages the guide rail end treatment.

## References

- [1] NHTSA, Traffic Safety Facts 2005, National Traffic Safety Administration, US Department of Transportation, Washington, DC, December 2006.

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