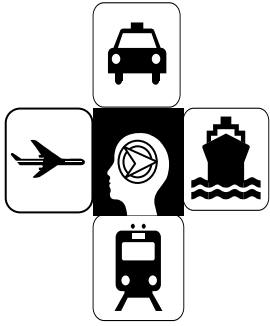


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## *Tech Brief*

### **Human Factors Evaluation of Design Ideas for Prevention of Vehicles Entrapment on Railroad Tracks Due to Improper Left Turns**

FHWA-NJ-2005-019

December 2005

#### **Summary**

The purpose of this project was to investigate the problem of vehicle entrapment at grade crossings due to attempts of making left turns to roadways which are parallel to the railroad. This project investigated selected highway-rail grade crossing on NJTRANSIT's lines in New Jersey. Possible design ideas for solving such vehicle entrapment problems were examined using human subjects both in the lab and in the field.

#### **Background**

Railroad crossings in urban areas in general pose a potential hazard for drivers on the road, even under the presence of warning signs and devices. NJTRANSIT recorded a total of 91 accidents at railroad crossings in New Jersey between 1994 and 1998. All the crossings are equipped with either active or passive devices or a combination of both. The numbers of accidents at railroad grade crossings are found to be particularly

high at places where streets run parallel to the railroad tracks. Motorists who make turns across the tracks to enter the road parallel to the tracks are sometimes confused and found entrapped on tracks. Existing railroad grade crossings on selected highway-rail grade crossings on NJTRANSIT's lines in New Jersey were investigated for potential problems and studied for design solutions.

## **Research Approach**

The research approach for this project consisted of several steps:

1. Data analysis of accident records,
2. In-lab experiment for studying the effect of design solutions on the performance of driver's roadway vs. railroad judgment including: development of the experiment, conducting the experiment, and data analysis of the experiment results,
3. Field validation study including: development of the field study scope, selection of field study sites, conducting the field study using video cameras, and data analysis for the field study results, and
4. Recommendations to conclude the project.

## **Findings and Conclusions**

Results from the laboratory experiment suggest that confusion of the drivers attempting to make left-turns at railroad crossings can be reduced by highlighting the grade area, including pavement and center line marking and coloring the road-rail track intersection area with reflective painting. A field study was conducted to validate design ideas suggested in the laboratory experiment. Three railroad crossings were selected at Hackensack, NJ for the field study. Video recordings were taken before and after the treatments were applied. The video recordings took place between October, 2002 and April, 2003.

Results of the field study showed that the grade crossing at Clinton Place had a superior performance when compared to the other two locations. Clinton Avenue, being treated with both grade crossing area painting and pavement marking, showed significantly safer vehicular movements in terms of reduction of unsafe left turn and reduction of stop on track cases. Although it showed some reduction in unsafe driving behaviors, no significant difference was observed between pre-treatment and post-treatment conditions for the Central Avenue grade crossing (treated with grade crossing area painting). Similarly, no significant reduction in unsafe driving behaviors was observed after the treatment was applied to the Euclid Avenue grade crossing (treated with pavement marking). Based on the current project, combining the two treatments showed the best results as evidenced by observations at Clinton Place and grade crossing areas painting alone (Central Avenue) or pavement marking only (Euclid Avenue). In order for the research team to expedite evaluating the effectiveness of the above mentioned treatments, reflective paint was applied to highlight railroad crossing surfaces in two locations. Although reflective paint on surfaces is believed to have equivalent effectiveness as compared with surface materials dyed with reflective paint, the latter is recommended by the research team for minimizing maintenance efforts.

## **Recommendations**

In addition to the potential risk of vehicles turning onto railroad tracks, the specific roadway/railroad configurations being investigated in the current project put a heavy mental workload on drivers of both roadway directions (perpendicular to the railroad tracks and parallel to the tracks). Drivers need to make quick and accurate decisions upon approaching and crossing the grade crossing. Although the problem of vehicle-to-vehicle collisions is not in the scope of this project, it is believed that there is a high incident rate of vehicle-to-vehicle or vehicle-to-pedestrian collisions in the specific roadway/railroad configurations. The assessment is evidenced by near misses of collision and many failure-to-yield cases observed in our field study. Based on the experience learned from the current project, the research team would suggest installing traffic lights at those grade crossings if eliminating those grade crossings is not feasible.

The traffic lights should be installed throughout the entire section in order to ensure consistency of traffic controls in similar roadway/railroad configurations. Consistency and standardization is always beneficial to human users of any human-system interface, such as traffic controls being studied in this project.

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A final report is available online at:

<http://www.state.nj.us/transportation/research/research.html>

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research Technology Transfer Group at (609) 530-3722, or send an e-mail to [Research.Division@dot.state.nj.us](mailto:Research.Division@dot.state.nj.us) and ask for:

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