TECHSUMMARY *January 2020*

State Project No. DOTLT1000149 / LTRC Project No. 17-1SA

Evaluating the Effectiveness of Regulatory and Warning Signs on Driver Behavior near Highway/Rail Crossings

INTRODUCTION

In the United States, approximately 211,893 highway-rail grade crossings exist, of which 5,262 are in Louisiana. In recent years, the number of crashes at these sites has been steadily increasing, resulting in a considerable number of injuries and fatalities as well as an initiative to develop a plan of action for addressing such safety hazards. Aside from safety, these events also create liability issues for state and local government, railroad companies, and private owners as well as stifle railroad operation/resource delivery. Currently, the common approach to minimize these occurrences is signage, specifically, warning and regulatory signage. This study aimed to evaluate the effectiveness of the addition of this type of signage on driver behavior at highway-rail crossings, specifically within the dynamic envelope zone (DEZ, pictured in Figure 1). Determining the effectiveness of the signage involves video data collection at selected sites, manually recording driver behavior from video data, and performing comprehensive comparative analysis of the driver behavior data.

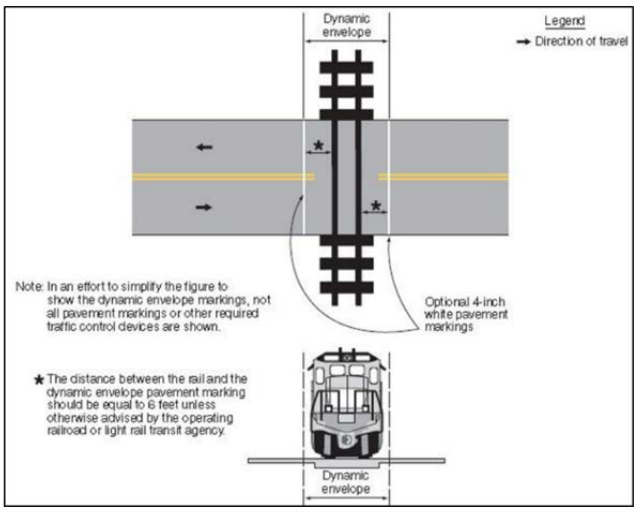

Figure 1
Diagram of the DEZ

OBJECTIVE

- Conduct a literature review of completed and ongoing studies that relate to using signage to improve safety
- Confirm with DOTD the list of locations with known problems of stopped vehicles within the dynamic envelope of crossings
- Equip the selected locations with traffic data collection devices and collect "Pre-Installation" data
- Install accompanying signage at selected locations
- Collect "Post-Installation" traffic data
- Determine the effectiveness of the signage through comparative analysis of the "Pre-Installation" and "Post-Installation" data

METHODOLOGY

The literature review conducted for the project cites several studies that analyze the interactions between drivers and safety systems at highway-rail crossings. Most of the studies were limited to evaluating traffic warning devices, signage, and specific pavement markings. Despite conclusions of general ineffectiveness, signage with specific language was suggested to be more influential on driver behavior and crash reduction at highway-rail sites. Based on previous

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PRINCIPAL INVESTIGATOR:
Julius Codjoe, Ph.D., P.E.

LTRC CONTACT:
Kirk Zeringue, P.E.
225.767.9169

FUNDING:
SPR: TT-Fed/TT-Reg

Louisiana Transportation Research Center

4101 Gourrier Ave
Baton Rouge, LA 70808-4443

www.ltrc.lsu.edu

studies, a list of candidate sites, comprising both urban and rural locations, was confirmed with appropriate DOTD personnel and eight locations were chosen. At each location, the research team, with aid from the DOTD District Traffic Operations Engineers, undertook the mounting of video surveillance systems while appropriate DOTD personnel were responsible for signage installation. Video data was collected for a set period before and after signage installation: following two "novelty" periods in order to give drivers a chance to become accustomed to signage existence and, in turn, yielding natural driver behavior for data collection. Researchers manually reviewed all video data collected and driver behavior was logged for comparative analysis.

Major Violation	Vehicle stops completely within the DEZ.
Minor Violation	Vehicle does not stop within the DEZ, or does not stop at the stop line/ performs a rolling stop with a vehicle queue.
Safe Maneuver	Vehicle stops before the stop line with a queue and waits for the area between the intersection and the tracks to become clear.

Figure 2
Description of compliance levels

Specific parameters and categories were chosen to properly characterize driver behavior, commonly referred to as level of compliance (LOC, categorized in Figure 2). The video data was reviewed and driver behavior was recorded with respect to these parameters and categories. A simple percentage change analysis was conducted with the data collected at each site as well as a collective data set comprising all sites. Following the percentage change analysis, a chi-square test was conducted for the same data sets to determine if any statistically significant changes in LOC exist. Lastly, a Market Basket Analysis (MBA) was performed to track associations between the varying parameters that characterize driver behavior within the study.

CONCLUSIONS

Overall, the results did not show that signage installation was effective in influencing driver behavior to enhance safety at highway-rail grade crossings near roadway intersections with history of crashes. Results of the percentage change analysis were varied among safe maneuvers, minor violations, and major violations following both novelty periods. For example, decreasing percentage changes for major violations after the first novelty period were reported at Sites A, B, C, and E as -9.4%, -86.2%, -29.2%, and -17.1%, respectively. Following the second novelty period, the percentage changes were reported as -20.8%, -77.6%, 12.9%, and -45.2%. Increases in major violations after the first novelty period were reported at Sites D, F, G, and H as 44.8%, 85.0%, 88.7%, and 45.2%, respectively. After the second novelty period, percentage changes were observed as -26.8%, 5.1%, -32.3%, and -55.9%. The results of the chi-squared test for the first novelty period indicated no statistically significant association between signage installation and the level of compliance. However, the results of the test for the second novelty period showed the opposite. The preliminary MBA analysis confirmed the results suggesting that the R8-8 had a minimal effect on driver behavior except at sites which experienced increases in the safety violations. The comprehensive MBA identified parameters, which may have attributed to this effect.

In conclusion, the results of the study could not confirm that regulatory signs are effective in influencing driver behavior and level of compliance at highway-rail crossings. Results varied among all sites; in some instances, violations (both major and minor) significantly decreased, then significantly increased and vice versa. The same held true for safe maneuvers, meaning that no clear relationship was found between the signage presence and the behavior of drivers. This indicates that other factors could influence the level of compliance at highway-rail crossings and other methods of influence should be investigated/explored.

Based on the results of the study, the research team recommends that in addition to regulatory signage, other methods like using pavement markings, flashing lights/bells, and in-vehicle auditory warnings should be employed in order to improve safety at highway-rail grade crossings near roadway intersections with history of crashes.