

**GUIDANCE FOR SITE SELECTION, SAFETY EFFECTIVENESS EVALUATION, AND CRASH
MODIFICATION FACTORS OF MEDIAN CABLE BARRIERS IN TENNESSEE
RES2013-28**

PURPOSE OF THE PROJECT

Tennessee Department of Transportation (TDOT) has been installing Median Cable Barrier Systems along some highway segments across the state since 2006. Among the intended benefits of the cable barriers was the prevention of cross-median crashes which occurs when a vehicle leaves its travel way enters or crosses the median dividing the highway directional lanes and collides with vehicles in the opposite direction. After more than three years since installation of most cables throughout the state; TDOT approved Safety Effectiveness evaluation study to determine whether the cables have been effective in reducing significant number of collisions and injury severities as initially intended. The study which is still in progress is also evaluating the impact of different geometric features as well as traffic characteristics to the safety performance of the cable barriers. In addition, the study is developing crash modification factors (CMF) for segments with median cable barriers relative to no cable barrier segments. This phase of the study evaluates all cable segments installed in Tennessee from 2006 to 2010, a continuation of already completed Phase 1 and 2 which covered only 27 pilot cable segments in five counties installed in 2006.

SCOPE AND SIGNIFICANCE OF THE PROJECT

This phase of the study gathered literature review on the criteria and warrants for selecting locations to install median cable barriers. Literature showed that median width, crash history, vehicles median crossover frequency, traffic volume, clear zone, slopes and alignment, roadside objects, posted speed, and benefit cost ratio are the main factors considered when selecting locations for installing median cable barriers. Three years of crash data before and after the cable barriers were installed along these 577 segments were evaluated in terms of descriptive statistics of critical factors associated with median related crashes whose occurrences could have been prevented or was impacted by the presence or absence of the median cable barriers. Safety effectiveness evaluation was performed following the procedures outlined in the 2010 HSM. The HSM procedures apply crash modeling in the form of safety performance functions (SPF), and Empirical Bayes (EB) before and after observational. Findings from safety effectiveness study are expected to reinforce future expansion of the program as well as respond to the public perception on the program. The study therefore evaluated safety effectiveness with respect to the reduction in the number of crashes, injury severities and fatalities.

EXPECTING OUTCOMES

Statistical before and after approach utilizing Empirical Bayes (EB) described in Highway Safety Manual (2010 HSM) was used to calculate the cable barriers Safety Effectiveness. The approach properly account for regression to the mean while normalizing for differences in traffic volume and cable segment length in relation to crash and injury severity history prior to and after the installation of the cable barriers. The individual segments safety effectivenesses were also averaged per corresponding TDOT regions, counties and individual routes. The following are some of the key Safety Effectiveness findings (Details in Chapter 5):

- Statewide cable barriers Safety Effectiveness for fatal crashes stands at 94%.
- Statewide Safety Effectiveness for incapacitating injury crashes stands at 92%.
- Safety Effectiveness for fatal and incapacitating injury crashes combined stands at 92%.
- Safety Effectiveness for fatal and all injury crashes combined is 85%.
- Statewide Safety Effectiveness for non-incapacitating injury crashes is 84%.
- Safety Effectiveness for injury crashes combined stands at 85%.

- Each of the TDOT regions have above 80% safety effectiveness for all fatal and injury crashes when cable barriers were averaged per TDOT regions.

Analysis also compared direct percentage reduction or increase in injury severities whereas high percentage reduction is taken as a positive indicator to the effectiveness of the cables as follows:

- Statewide fatal crashes were reduced by 82% after the cables installation.
- Statewide incapacitating injury crashes were reduced by 76%.
- Statewide non-incapacitating injury crashes were reduced by 60%.
- Statewide fatal and all injury crashes combined were reduced by 64%.
- Statewide total killed were reduced by 83% as a result of cable barriers.
- Statewide total injured went down by 71% as a result of cable barriers.
- Incapacitating injuries went down by 81% as a result of cable barriers.
- Statewide crashes involving two or more vehicles went down by 92%.
- Property Damage Only (PDO) crashes went up slightly after cable barriers.

The following are the overall impact of these variables to crash frequencies:

- **Impact of Cable Offset and Median Width:** The wider the cable offset the lower the number of fatal and injury crashes involving vehicles hitting cable barriers.
- **Impact of Inside Shoulder Width:** Segments with wider shoulder widths were found to experience less number of crashes compared to narrow shoulder width segments.
- **Impact of Differential Elevation:** High differential elevations increases the likelihood of median related crashes.
- **Impact of Degree of the Curve:** Curved segments appeared to have higher probability of fatal and injury crashes compared to straight segments.
- **Impact of Traffic Volume per Lane to Safety Performances:** Number of crashes was found to increase with increase in traffic volume (AADT).

PUBLICATIONS

1. Chimba D., Evarist, R., Allen, S., and Waters, J. Digesting the Safety Effectiveness of Cable Barrier Systems by Numbers. Submitted to Journal of Transportation Research Part A: Policy and Practice. 2016, *Under Review*
2. Chimba D., Evarist, R., Allen, S., and Waters, J. Exploring the Post-Impact Vehicular Responses with Median Cable Barriers. Submitted, *Under Review*
3. Chimba D., Evarist, R., Allen, S., and Waters, J. Crash Modification Factors for Median Cable Rail Systems in Tennessee. Submitted, *Under Review*

TIME PERIOD

The project period is 60 months starting 8/1/2013 to 7/31/2018.

CONTACT INFORMATION

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