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GUIDELINES FOR LOCATING CABLE BARRIER TERMINI AND HOTSPOT PRIORITIZATION

CABLE BARRIER TERMINI GUIDELINES

Wisconsin Department of Transportation (WisDOT) has been installing cable barrier at some of the identified cross median crash (CMC) hotspots since 2006. After choosing hotspots for cable barrier installation, WisDOT regions are consulted to identify suitable termini for cable barrier installation. Over the last few years there have been multiple instances where CMC occurred in very close proximity to the cable barrier installations. Thus, there is a need to develop a procedure to identify termini for cable barrier installation at hotspots.

An extensive literature review was performed to identify any existing guidelines for location of cable barrier termini. However, no guidelines were found in the literature. Therefore, the research team developed guidelines based on findings from the CMC research. Factors affecting CMC have been identified using traditional regression approach. Additionally, the research team also developed spatial statistical methods to study CMC and factors affecting them. First, the findings from the two approaches will be summarized. Following this the guidelines for cable barrier termini are presented.

Factors Affecting CMC

Traditional Regression Approach

All the divided highways without barrier in Wisconsin were divided into half-mile segments. Roadway and traffic characteristic data assembled from the Photolog and STN databases were then attributed to each road segment. The following characteristics were assigned:

- AADT
- Median width
- Bridges
- Curves by direction
- Entrance ramps
- Exit ramps

Presence of bridges, curves and ramps were modeled as binary variables indicating their presence or absence. The roadway segments generated in the segmentation procedure were then fit to a regression model to formulate a crash frequency prediction model. . The CMC data have a variance/mean ratio of 1.42 which indicates overdispersion. As a result, the negative binomial model was used in this analysis, which is consistent with other CMC frequency analyses. Analyses were performed by considering only multi-vehicle CMC as well as all (including single-vehicle) CMC. Since single-vehicle and multi-vehicle CMC have the same causal factors and differ only in the crash outcome (collision with a vehicle in opposing lanes), the results from the analysis of all CMC are considered in this research.

The roadway factors that were found to be statistically significant include:

- Median width (CMC increase with decreasing median width)
- Bridge (CMC increase with presence of bridge)
- Left curve (CMC decrease with presence of left curve)
- Entrance ramp (CMC increase with presence of entrance ramp)
- Exit ramp (CMC increase with presence of exit ramp)

Spatial Statistical Approach

The traditional regression approach identified the factors affecting CMC. However, there are two limitations: 1. The extent of spatial influence of bridge, curve, ramps are not quantified and 2. Roadway features can confound the effects of others (for example: entrance ramp and exit ramp). In order to address these two issues, the research team also developed spatial statistical approaches for studying CMC. Specifically, cross K-functions were developed and used to study the effect of roadway features on CMC. In this analysis only the CMC that occurred on interstate highways were considered.

The spatial statistical analysis resulted in the following findings:

- CMC cluster downstream of bridges up to a distance of 100 meters.
- CMC cluster up to 300 meters downstream from start of entrance ramps.
- There is no relationship between CMC and exit ramps.
- CMC cluster downstream of left curves.
- CMC cluster at end of right curves.

Guidelines for Cable Barrier Termini

CMC hotspots have been identified by considering only multi-vehicle CMC so far. However, numerous single-vehicle CMC have occurred within or in the vicinity (1 mile up or downstream) of CMC hotspots. Single-vehicle CMC could very well have been a multi-vehicle CMC but for the fact that the crossing vehicle found a safe gap in opposing lanes. Therefore, the research team strongly recommends that the end points of hotspots be extended to include single-vehicle CMC within the vicinity of the hotspot. Additionally, based on the factors found to affect CMC the termini should be extended to the following roadway features in the vicinity:

1. Interchanges: 1000 ft downstream of entrance ramp (painted) gore.
2. Bridges: 350 ft downstream
3. Curves: Through the length (L) of the curve and additional one-fourth the length of the curve (0.25L) on each side.

HOTSPOT PRIORITIZATION

Currently there is no procedure in place to prioritize CMC hotspots nor was any information found in the literature. The following steps are recommended for hotspot prioritization considering crash history, crash rate and presence of factors associated with CMC.

- For each hotspot compute CMC rate including single-vehicle CMC within and in the vicinity (1 mile) of the hotspot.
- Prioritize hotspots by CMC rate
- For hotspots with identical crash rate prioritize by hotspot with greater number of multi-vehicle CMC. Higher the number of multi-vehicle CMC, the greater the benefit-cost ratio.
- For hotspots with identical number of multi-vehicle CMC prioritize by considering the number of curves, bridges and ramps. The greater the number of these features, higher the priority of the hotspot because these features were found to significantly affect CMC.