Measure Name: Dynamic Envelope Marking

Definition: Painting of the dynamic envelope to make the area more pronounced to reduce motorist stopping on the tracks.

Tags:

Type of Incident:

- ☐ Non-Motorized Users Only
- ☒ Motor Vehicles Only
- ☐ Both

Intervention Strategy:

- ☐ Data: application and planning
- ☐ Education: outreach and messaging
- ☐ Enforcement: policy development and rulemaking
- ☒ Engineering: technological and physical deterrents

Type of Problem:

- ☐ Non-Motorized Users Violating Warning Devices
- ☐ Motor Vehicles Violating Warning Devices
- ☐ Vehicle ROW Incursion
- ☒ Vehicle Congestion
- ☐ Blocked Crossing
- ☐ Vehicle Hang-up

Measure Category:

- ☐ Risk Assessment
- ☐ Policy and Enforcement
- ☐ Collaboration, Training, and Education
- ☒ Public Communication
- ☐ Physical Barriers
- ☐ Detection and Lighting
- ☐ Infrastructure Modification
- ☐ Post-Incident Management
- ☒ Warning Devices

Description

The MUTCD defines the "Dynamic Envelope" as "the clearance required for light rail transit traffic or a train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure." [1] This measure refers to the painting of the dynamic envelope and adding signage to visually highlight the clearance needed for trains to safely pass. The goal is to reduce the number of vehicles that stop within the dynamic envelope, thus reducing the possibility of a vehicle-train collision.

Dynamic envelope pavement marking has helped reduce the frequency of vehicles that come to stop on the tracks, according to an evaluation conducted at a crossing in Fort Lauderdale, FL [2]. The Fort Lauderdale study reports at least 15 percent reduction in the number of motorists that stopped in the dynamic envelope following installation of dynamic envelope pavement marking and accompanying signage [2]. Following a successful demonstration in that project, the Florida Department of Transportation (FDOT) initiated a program to install dynamic envelope treatments at over 4,000 crossings across Florida with an overall estimated cost of nearly $60 million [3].

Additional search terms: *pavement marking, colored crossing, danger zone, do not stop on tracks*

Advantages

- Dynamic envelope pavement marking is effective in reducing the number of vehicles that come to a stop on the tracks. [2]
- Dynamic envelope pavement marking is relatively low cost and simple to install.
- Dynamic envelope pavement marking can be effective at reducing drivers' likelihood of committing descending gate violations. [2]
- Dynamic envelope pavement marking can be effective at reducing vehicle right-of-way incursions by making the crossing area more pronounced.

Drawbacks

- Markings may not be very durable when subject to heavy traffic use. [4]
- Rain can make markings difficult to see. [4]
- Snow and ice can cover the markings reducing its effectiveness.
- Ensure that the surface material is not hazardous to motorcyclists or cyclists in wet conditions. [5]

Notable Practices

- Consider safety and operational impacts on train and roadway users when scheduling installation of the dynamic envelope pavement marking.

- Develop a maintenance strategy to keep bright color of the pavement marking to maintain its effectiveness. [5]
- Dynamic envelope pavement marking can be more effective where curved tracks cross roadway because motorists may have more difficulty determining the location of the crossing zone. [6]
- Dynamic envelope pavement markings should not be placed perpendicular to the roadway at skewed grade crossings. [1]
- Marking the dynamic envelope just beyond 3 feet from the rail is a current practice applicable to freight rail. [4]

References

[1] Federal Highway Administration. (2012). Manual on Uniform Traffic Control Devices.

> Excerpt: The Manual on Uniform Traffic Control Devices (MUTCD), by setting minimum standards and providing guidance, ensures uniformity of traffic control devices across the nation. The use of uniform TCDs (messages, locations, sizes, shapes, and colors) helps reduce crashes and congestion, and improves the efficiency of the surface transportation system. Uniformity also helps reduce the cost of TCDs through standardization. The information contained in the MUTCD is the result of years of practical experience, research, and/or the MUTCD experimentation process. This effort ensures that TCDs are visible, recognizable, understandable, and necessary. The MUTCD is a dynamic document that changes with time to address contemporary safety and operational issues.

[2] Gabree, S., Chase, S., and DaSilva, M. (2014). Effect of Dynamic Envelope Pavement Markings on Vehicle Driver Behavior at a Highway-Rail Grade Crossing. Technical Report No. DOT/FRA/ORD-14/04. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

> Abstract: The U. S. Department of Transportation's (U.S. DOT) Research and Innovative Technology Administration's (RITA) John A. Volpe National Transportation Systems Center (Volpe Center), under the direction of the U.S. DOT Federal Railroad Administration (FRA) Office of Research and Development (R&D), conducted a research study to evaluate the effectiveness of roadway pavement markings placed within the dynamic envelope, the region between and immediately adjacent to the tracks at a highway-rail grade crossing, and new corresponding signage at the Commercial Boulevard grade crossing in Ft. Lauderdale, FL. The goal of the added markings and signage is to reduce the number of vehicles that come to a stop within the dynamic envelope, a violation of most applicable State highway traffic laws, thus reducing the possibility that a vehicle is present on the tracks when a train approaches.
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> Results indicate that the addition of the dynamic envelope pavement markings and modified signage reduced the number of vehicles that stopped within the dynamic envelope zone and increased the number of vehicles that stopped properly—safely behind the stop line. Though these results seem to indicate that dynamic envelope pavement markings and signage may be an effective way to increase safe behavior, these safety enhancements have only been studied at one crossing. Additional field testing is necessary before recommendations for wider use can be made.

[3] Florida Department of Transportation. (2019). FDOT Secretary Directs Unprecedented Rail Safety Measures, Launches Statewide Education Initiative.

> Excerpt: The attached memorandum from the FDOT Chief Engineer was sent to FDOT's senior leadership today and work to implement the dynamic envelopes on more than 4,000 rail crossings across Florida is

anticipated to be completed by March 2022. The estimated cost is nearly $60 million and will be absorbed by FDOT over the next three fiscal years.

[4] U.S. Department of Transportation. (2019). Highway-Rail Grade Crossing Handbook – Third Edition.

Abstract: The purpose of the *Highway-Rail Crossing Handbook, 3rd Edition* is an information resource developed to provide a unified reference document on prevalent and best practices as well as adopted standards relative to highway-rail grade crossings. The handbook provides general information on highway-rail crossings; characteristics of the crossing environment and users; and physical and operational changes that can be made at crossings to enhance the safety and operation of both highway and rail traffic over such intersections. The guidelines identified and potential alternative improvements presented in this handbook reflect current best practices nationwide.

[5] SAFER-LC. (2022, March 29). Coloured Pavement Markings Indicating LC Danger Zone. SAFER-LC Toolbox.

Description: This webpage provides information on implementing skirts under the crossing gates in Europe, including recommendations, considerations for implementation, and relevant research results.

[6] Cambridge Systematics, Rail Strategy Study – Grade Crossing Toolkit, July 2018.

Excerpt: The Grade Crossing Toolkit provides information and tools to identify candidate crossing improvements across a range of options. The Toolkit describes rail crossing treatments, such as grade separations, closures, consolidation, passive treatments, active devices, quiet zones, and specialized treatments for pedestrian/bicycle issues.

Additional Resources

Related Measures

- LED Enhanced Signage
- Traffic signal preemption
- Pre-Signals
- Queue Cutter

Images

Figure 1. Example of dynamic envelope pavement marking in West Palm Beach, FL from Google Street View

Figure 2. Example of dynamic envelope pavement marking in Everett, MA from Google Street View

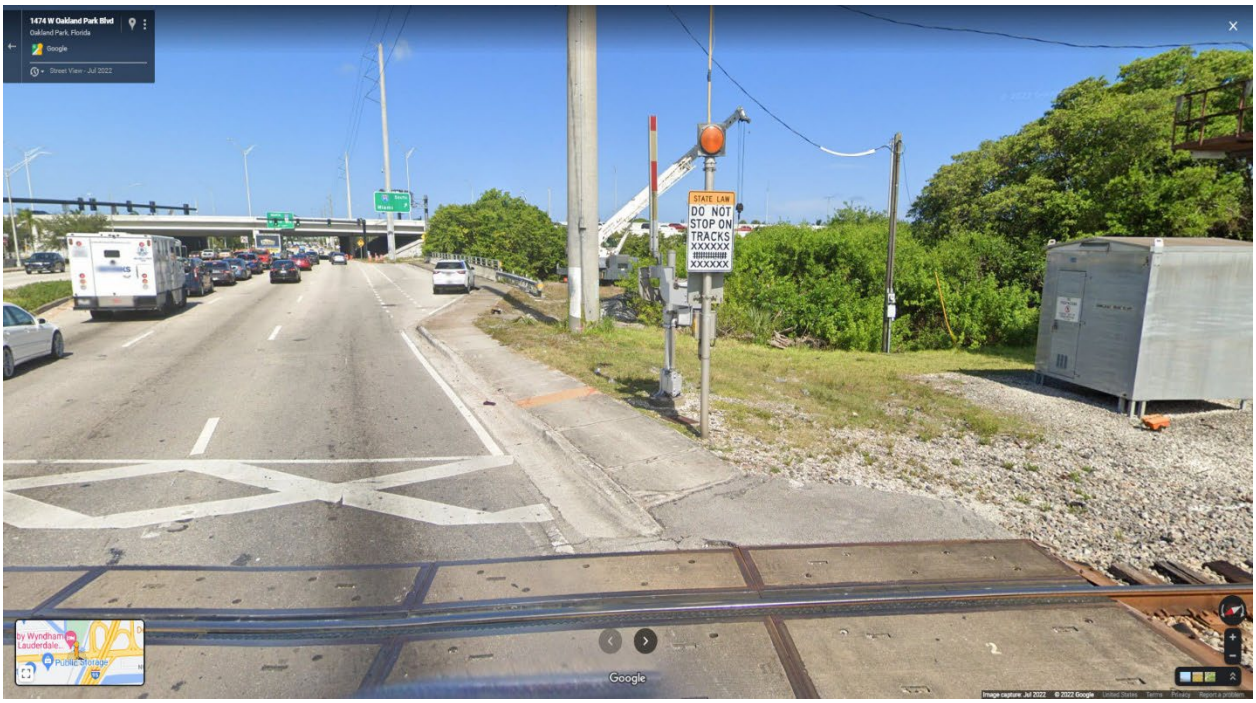

Figure 3. Example of dynamic envelope pavement marking signage in Oakland Park, FL from Google Street View