Measure Name: Barrier gates

Definition: Installation of a specialized automatic roadway gate at grade crossings to prevent vehicle penetration if driver tries to break through.

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

Barrier gates refers to the installation of a specialized automatic gate for the roadway approach to a grade crossing that prevents vehicle penetration if driver tries to break through. It functions similarly to a normal automatic gate but is built to withstand an impact by an oncoming vehicle. The system consists of a housing containing electromechanical components that lower and raise the gate arm, the arm itself, and a locking assembly bolted to a concrete foundation to receive and hold the lowered gate arm in place [1]. The barrier gate arm typically consists of three steel cables, the top and bottom of which are enclosed aluminum tubes, to complete this energy-absorbing system.

Trial demonstrations have been conducted in California, Wisconsin, and Alabama [2] [3]. The barrier system installed in Monroe, AL was credited with preventing a 2005 vehicle-train collision. However, the effectiveness is not well understood based on limited studies on this measure.

Additional search terms: *gate arm, barrier, vehicle arresting barrier, vehicle arresting system*

Advantages

- Barrier gates provide an automatic visual warning and restriction when a train is approaching.
- Barrier gates have been tested to safely stop a pick-up truck traveling at 45 mph. [1]
- FRA has indicated that a barrier gate, if equipped with monitoring device, may be used to enforce a nighttime closure for partial quiet zones. [1]

Drawbacks

- Barrier gates could injure occupants of small vehicles during higher speed impacts, and may not be effective for heavy vehicles at lower speeds. [2]
- Barrier gates can be very expensive to purchase, install, and maintain. [3] [4]
- Barrier gates may take longer to repair or replace when damaged compared to normal automatic gates.
- Barrier gates need space in the median for the concrete foundation to receive and hold the lowered gate arm. [1]
- Snow must be cleared from the large counterweight on the pivot end of the gate, or the gate can remain stuck in the raised or lowered position. [4]

Notable Practices

- Barrier devices should at least meet the evaluation criteria for a Manual for Assessing Safety Hardware (MASH) attenuator; stopping an empty 4,500-pound pickup truck traveling at 43 mph. [1] [5]
- Barrier gates should be considered as supplemental safety devices at:
    - Crossing with passenger trains;
    - Crossings with high-speed trains;
    - Crossings in quiet zones; or
    - As otherwise recommended by an engineering study or diagnostic team. [2]
- These gates require regular maintenance, inspection, and testing per 49 CFR Part 234. [6]
- Refer to relevant standards/guidelines for automatic gates in the Manual on Uniform Traffic Control Devices. [7].

References

[1] 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.

[2] Federal Highway Administration. (2002). Guidance on Traffic Control Devices at Highway-Rail Grade Crossings.

> Excerpt: The report is intended to provide guidance to assist engineers in selection of traffic control devices or other measures at highway-rail grade crossings. It is not to be interpreted as policy or standards. Any requirements that may be noted in this guidance are taken from the Manual on Uniform Traffic Control Devices (MUTCD) or other document identified by footnotes. These authorities should be followed. This guide merely tries to incorporate some of the requirements found in those documents. A number of measures are included which may not have been supported by quantitative research, but are being used by States and local agencies. These are included to inform practitioners of an array of tools used or being explored.

[3] Lindly, J., (2012). Driver Reaction at Railroad Crossings. University Transportation Center for Alabama.

> Abstract: The Alabama Department of Transportation desires to make highway/rail crossings in Alabama as safe as practicable. Accordingly, it initiated Federal Aid Project HPPF-AL49(900) to determine whether DOT crossing number 728478C where US 231 crosses the Gulf & Ohio Railways track in Troy, Alabama would be safer and if driver behavior would be modified when a StopGate™ stop arm developed by Quixote Transportation Safety was installed at the crossing. Personnel from the University Transportation Center for Alabama (UTCA) were employed to help in two areas of the project: to analyze driver behavior characteristics based on digital images provided by Quixote and to document crashes and/or near misses

at the crossing from data provided by the Gulf and Ohio railroad. Unfortunately, the digital images of driver reactions at the crossing supplied by a third party vendor were unusable for the analysis. Additionally, the Gulf & Ohio does not keep near miss records for the Shortline Railroad that includes this crossing. Without useful data, UTCA could not reach statistically verifiable conclusions. A limited amount of observations after the gates installation led to the following observation. The only violations that were observed occurred after flashing lights began but before full deployment of the gates; no vehicles drove around the gates, and there were no violations after the gates were locked in place. Rather than to attempt to draw firm conclusions from inadequate data, the UTCA team recommended instead to use the lessons learned from this installation to better prepare for future projects.

[4] Associated Press. (2014). Railroad seeks to replace problem-plagued crossing gates.

[5] American Association of Highway and Transportation Officials. (2016). Manual for Assessing Safety Hardware, Second Edition.

Abstract: This manual encourages consistency in testing and evaluation of roadside safety features. It includes a new matrix for cable barrier testing on slopes, modifications to several test vehicle dimensions, and updated test documentation requirements.

[6] Code of Federal Regulations. (2022). 49 CFR Part 234 – Grade Crossing Safety.

Excerpt: This This part prescribes minimum maintenance, inspection, and testing standards for highway-rail grade crossing warning systems.

[7] 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.

Additional Resources

Related Measures

- Automatic gates
- Four-quadrant gate
- Long gate arm
- Traffic channelization
- Pre-signals

Images

Figure 1. Barrier gates from Google Street View

Figure 2. Barrier gates from Google Street View

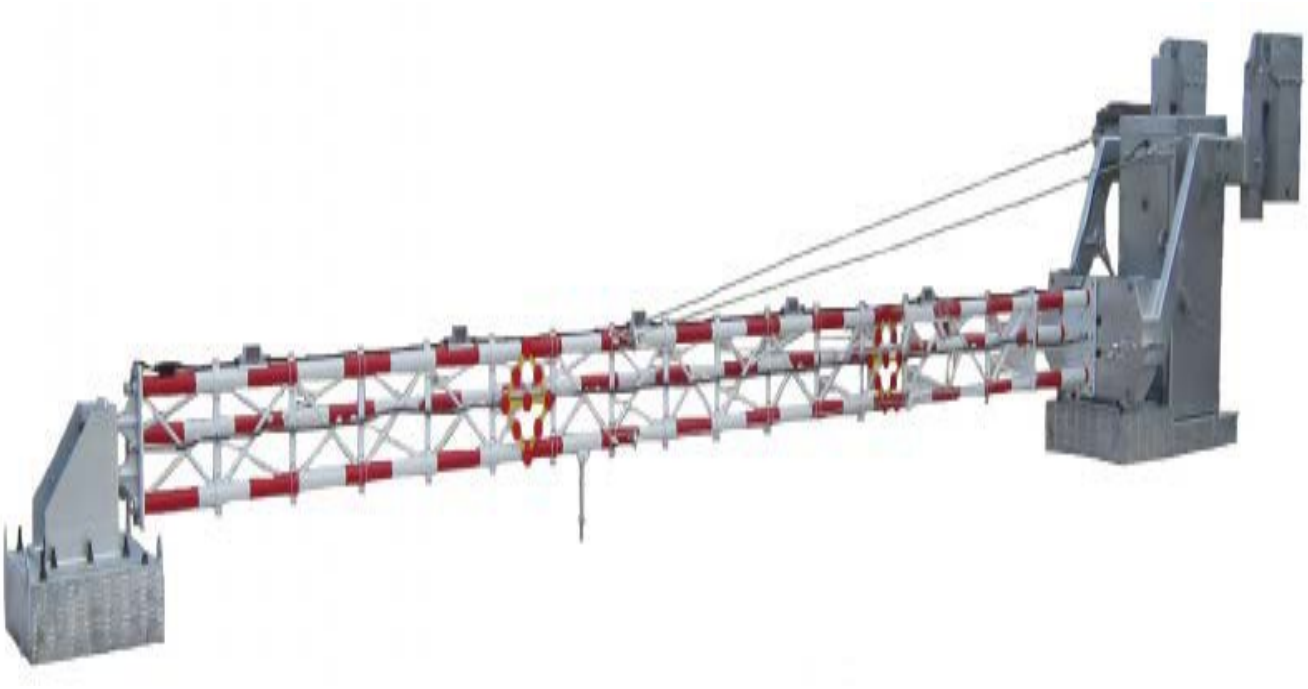

Figure 3. Example of barrier gate
Image Credit: FRA, Grade Crossing Handbook