Measure Name: Automatic gates

Definition: Installation of automatic roadway gates at grade crossings.

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

Automatic gates are located at roadway approaches to block road user access to the grade crossing during an activation. These are also referred to as two quadrant gates if installed at two-way streets, as they block the approach lanes on each side of the crossing. The automatic gate consists of a drive mechanism and a fully retroreflectorized red- and white-striped gate arm with lights [1]. When activated, this traffic control device gives road users a positive indication of incoming rail traffic and blocks access to the crossing by extending across the approaching highway lanes when in the down position.

The effectiveness of upgrading a crossing from passive to active with the addition of flashing lights and automatic gates has been estimated to be 83 percent [3]. The effectiveness of gates may be further enhanced by the use of channelizing devices or raised median islands to discourage driving around lowered automatic gates [1].

Additional search terms: *barrier, half-barrier, boom*

Advantages

- Automatic gates provide a visual warning and restriction when a train is approaching.
- Automatic gates result in increased road user compliance with activated grade crossing signals. The effectiveness of upgrading a crossing from passive to active with the addition of flashing lights and automatic gates has been estimated to be 83 percent. [3]

Drawbacks

- Automatic gates do not block the entire roadway, so driver can drive around the lowered gate if no medians or channelization is used. [4]
- Drivers are less likely to comply with the warning devices if the wait time at active crossing is too long. [5]
- May be a high-cost treatment. [6]

Notable Practices

- Refer to relevant standards and guidelines for automatic gates in the Manual on Uniform Traffic Control Devices. [1]
- Automatic gates will require regular maintenance, inspection, and testing per 49 CFR Part 234. [7]

- The automatic gate shall consist of a drive mechanism and a fully retroreflectorized red- and white-striped gate arm with lights. When in the down position, the gate arm shall extend across the approaching lanes of highway traffic. [1]
- Gate arms shall have at least three red lights. When activated, the gate arm light nearest the tip shall be illuminated continuously and the other lights shall flash alternately in unison with the flashing-light signals. [1]
- When there is a curb, a horizontal offset of at least 2 feet shall be provided from the face of the vertical curb to the closest part of the signal or gate arm in its upright position. When cantilevered-arm flashing-light signal is used, the vertical clearance shall be at least 17 feet above the crown of the highway to the lowest point of the signal unit. [1]
- Automatic gates can be installed on the other side of the sidewalk to also block pedestrians. However, it is preferred that pedestrian gates are mounted on a mechanism separate from the roadway gates, which prevent a pedestrian from raising the vehicular gate if they try to lift the pedestrian gate. [1] [2]
- Damaged or deteriorated gates should be replaced. [1]
- The entrance gate arm mechanism shall be designed to fail safe in the down position. [1]
- It is desirable to place crossing gates perpendicular to the direction of travel on the approach roadway. [2]
- Where automatic gates are installed, the stop line should be located approximately 8 feet in advance of where the gate arm crosses the highway surface. [2]
- Ensure that the counterweights and support arms for the automatic gates for vehicular traffic do not obstruct the sidewalk when the gate is fully lowered. [2]
- Exit gates shall only be used as a last resort, when all other options to mitigate gate circumvention have been exhausted and an exit gate system is the only feasible option. [8]

References

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

Document 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] 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.

[3] U.S. Department of Transportation. (2007). Highway-Rail Grade Crossing Handbook – Revised Second Edition.

Abstract: The purpose of the Railroad-Highway Grade Crossing Handbook – Revised Second Edition is to provide a single 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 the physical and operational improvements that can be made at highway-rail grade crossings to enhance the safety and operation of both highway and rail traffic over crossing intersections. The guidelines and alternative improvements presented in this handbook are primarily those that have proved effective and are accepted nationwide.

This handbook supersedes the Railroad-Highway Grade Crossing Handbook, published in September 1986. This update includes a compendium of materials that were included in the previous version of the handbook, supplemented with new information and regulations that were available at the time of the update. Updates were drawn from the current versions of relevant legislation, policy memoranda, Federal Register notices, and regulatory actions.

[4] U.S. Department of Transportation Federal Railroad Administration. (2006). Use of Locomotive Horns at Highway-Rail Grade Crossings; Final Rule.

Description: The Final Rule on the Use of the Locomotive Horns at Highway Rail Grade Crossings (Code of Federal Regulations Title 49 Parts 222 and 229) permits the use of traffic channelization devices or non-traversable curbs that meet specific requirements as supplemental safety measures (SSM).

[5] Transportation Research Board. (2009). TCRP Report 137: Improving Pedestrian and Motorist Safety Along Light Rail Alignments.

Excerpt: TCRP Report 137: Improving Pedestrian and Motorist Safety Along Light Rail Transit Alignments addresses pedestrian and motorist behaviors contributing to light rail transit (LRT) safety and describes mitigating measures available to improve safety along LRT alignments.

[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.

[7] 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.

[8] Southern California Regional Rail Authority, SCRRA Highway-Rail Grade Crossings Recommended Design Practices and Standards Manual, January 2021.

Excerpt: This Manual was developed in 2009 and issued as a Recommended Design Practices and Standards Manual.

Additional Resources

Yeh, M., Multer, J., and Raslear, T. (2014). Journal of Transportation Safety & Security. An examination of the impact of five grade-crossing safety factors on driver decision making.

> Abstract: The authors applied signal detection theory to model the impact of five grade-crossing safety factors to understand their impact on driver decision making. The safety factors were improving commercial motor vehicle (CMV) driver safety through federal regulations, increasing locomotive conspicuity with alerting lights, increasing locomotive conspicuity with reflectors, increasing sight lines, and improving warning device reliability. The authors estimated sensitivity and bias for eight warning devices associated with each safety factor. The authors also calculated the proportion of variance accounted for by each safety factor and device type to examine the reliability of each on grade-crossing safety. Driver decision making improved due to the warning device type and the introduction of the safety factor. Of the two, warning devices exerted the most impact because they encouraged drivers to stop at grade crossings. Regulations to improve CMV driver safety, alerting lights, sight lines, and reflectors were generally equally effective in improving grade-crossing safety. A comparison of the results from the descriptive model to that produced by a more traditional accident analysis suggest that examination of accident frequency alone may minimize the impact of important safety factors and emphasizes the need to consider accident frequency with respect to human behavioral metrics.

Richards, S.H. & Heathington, K.W. (1990). Assessment of warning time needs at railroad-highway grade crossings with active traffic control. Transportation Research Record, 1254, 78-84.

> Excerpt: Research was conducted to assess the effects of warning time on driver behavior and safety at railroad-highway grade crossings with active traffic control, i.e., flashing light signals with and without automatic gates. The research included (a) an evaluation of driver response data gathered at three grade crossings in the Knoxville , Tennessee, area; and (b) a human factors laboratory study of drivers' warning time expectations and tolerance levels. In the field studies, the actions of over 3,500 motorists were evaluated during 445 train events. Based on the study results, warning times in excess of 30-40 sec caused many more drivers to engage in risky crossing behavior. The studies also revealed that the large majority of drivers who cross the tracks during the warning period do so within 5 sec from the time they arrive at the crossing. The human factors studies expanded the findings of the fieid evaluation. Specifically, the studies revealed that most drivers expect a train to arrive within 20 sec from the moment when the traffic control devices are activated. Drivers begin to lose confidence in the traffic control system if the warning time exceeds approximately 40 sec at crossings with flashing light signals and 60 sec at gated crossings. Based on the research, guidelines for minimum, maximum, and desirable warning times are presented. These guidelines are designed to minimize vehicles crossing during the warning period and promote driver credibility for the active control devices.

Related Measures

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

Images

Figure 1. Example of automatic gate at a grade crossing in Ramsey, NJ
Image Credit: Volpe Center

Figure 2. Example of automatic gate at a grade crossing in Katonah, NY
Image Credit: Volpe Center

Figure 3. Example of automatic gate at a grade crossing in Belmont, MA
Image Credit: Volpe Center

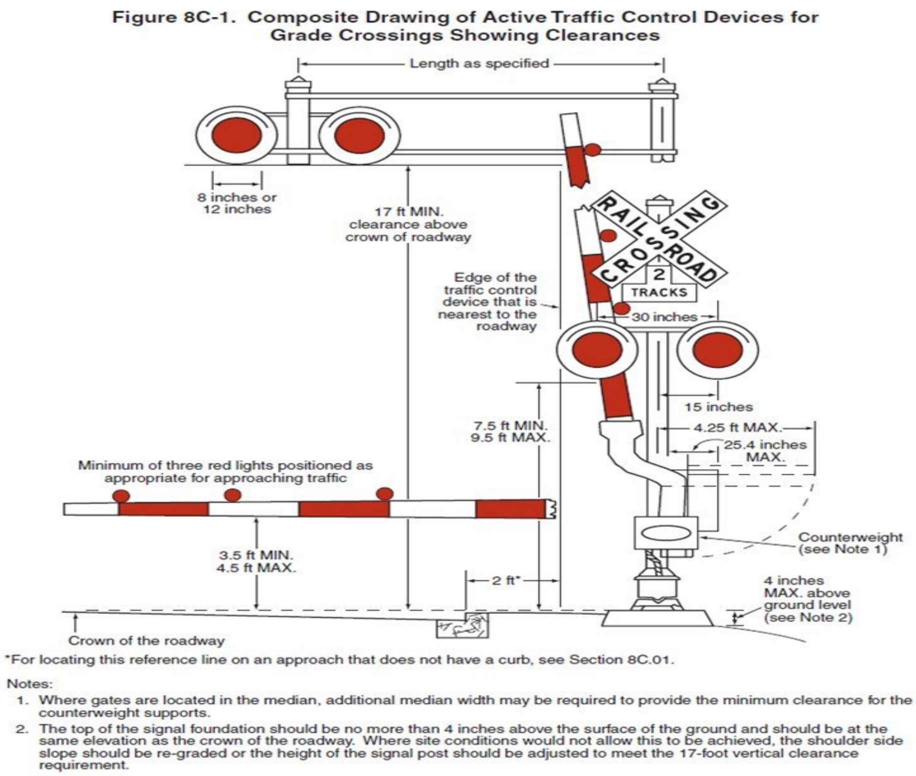

Figure 4. Composite drawing from MUTCD.
Image Credit: FHWA