Measure Name: Constant warning time

Definition: Operating warning signals/gates of highway-rail grade crossings for a specified amount of time, regardless of the speed of the incoming train.

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

Constant warning time describes activating warning signals/gates for a specified amount of time regardless of factors such as the speed of the train. As defined in the FHWA Manual on Uniform Traffic Control Devices (MUTCD), it is "a means of detecting rail traffic that provides relatively uniform warning time for the approach of trains or light rail transit traffic that are not accelerating or decelerating after being detected" [1]. This measure is intended to provide a predictable warning to motorists, including eliminating excessive waiting for slow trains or trains that have stopped on the tracks near the crossing [2]. This predictability may improve safety by improving the credibility of active grade crossing warning devices, which can reduce instances of violation of warning devices [2].

Constant warning time track circuitry functions by sensing a train approaching a crossing and measuring its speed and distance from the crossing. The warning equipment at the crossing will be activated to provide a pre-specified warning time (such as 20 seconds) [3]. Constant time warning equipment should deactivate if a train stops before reaching the crossing or moves away from the crossing to avoid causing unnecessary delays to highway traffic across the crossing [3].

Additional search terms: *track circuit, active warning*

Advantages

- Is particularly useful on tracks with variable-speed trains, such as intercity passenger trains or fast commuter trains interspersed with slower freight trains. [3]
- Provides motorists, pedestrians, and cyclists with the same duration of warning in every cycle. [4]
- Can improve the credibility of active grade crossing warning devices, resulting in increased compliance and safety. [2]
- Can reduce unnecessary delays due to blocked crossings. [3]

Drawbacks

- Train arrival time may be inaccurate/inconsistent if the train increases or reduces speed after it enters the crossing circuit. [3]
- Introduces increased installation and maintenance costs.
- Can be susceptible to failure due to weather conditions and component failure. [5]
- Constant warning time devices may not operate properly in electrified systems, and special devices or track circuits will likely be required. [3]

Notable Practices

- The standard minimum warning time set by the MUTCD and FRA regulations is 20 seconds, but a study should be conducted to consider increases due to factors such as: increased track clearance distances, proximity to other intersections, typical vehicles utilizing the crossing, pedestrian/non-vehicular usage, etc. [3]

- Excessive warning time can be a contributing factor in collisions because the credibility of the activated warning devices may be reduced, thus encouraging drivers to ignore warnings [3]. Therefore, the warning time should not be increased excessively.
- The calculated arrival time is based on the instantaneous speed of the train when it enters the crossing circuit, so changes in train speed after entering the circuit may cause deviations in the total warning time [2]. This should be considered in the design of a crossing.
- Four quadrant gate systems should only be used in locations with constant warning time detection. [1]

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] Federal Railroad Administration. (1981). Constant Warning Time Concept Development for Motorist Warning at Grade Crossings.

Excerpt: This report describes an investigation that was carried out to identify, evaluate and demonstrate the feasibility of concepts upon which a general purpose CWT system could be developed. The scope of the study includes train detection, signal transmission, and associated logic, but did not include motorist warning devices. Primary emphasis was placed on the development of c\n concepts rather than equipment for such systems.

[3] 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.

[4] 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.

[5] Bowman, B., McCarthy, K. (1986). The Use of Constant Warning Time Systems at Rail-Highway Grade Crossings.

Abstract: The results are presented of one task of a study sponsored by FHWA to determine the use and installation criteria of railroad constant warning time (CWT) systems. These systems measure train speed, direction, and distance from the crossing and estimate train arrival time. When a preselected minimum estimated arrival time is reached, the warning displays at the crossing are activated. The result is a more uniform warning time until train arrival for motorists than that provided by traditional train detection systems. Results of task activities indicate that no quantitative guidelines have been established by either the states or the railroads as to when CWT systems should be installed. Switching activity, annual average daily traffic maximum speed, and train speed variation were found to be variables, however, that were inherently considered when the need for CWT installations was determined. The necessary limits on each of these variables or their combinations that justify installation are apparently judgmental and performed on a crossing-by-crossing basis. Using information from the u.s. Department of Transportation (DOT)/Association of American Railroads (AAR) National Railroad-Highway Crossing Inventory along with the purchasing information supplied by CWT manufacturers, it was estimated that 6,300 crossings already have CWT installations. Discriminant analysis indicated that of all crossings, 19,400 may require CWT systems, which indicates that an additional 13 ,100 crossings have the physical and operational characteristics that may require CWT systems.

Additional Resources

Richards, S.H., Heathington, K.W. & Fambro, D.B. 1990. Evaluation of Constant Warning Times Using Train Predictors at a Grade Crossing with Flashing Light Signals. Transportation Research Record: Journal of the Transportation Research Board. 1254. 60–71.

Excerpt: This paper documents the results of field studies conducted to evaluate the effects of train predictors and constant warning time (CWT) on crossing safety and driver response measures. The studies were conducted at a single-track urban crossing controlled by flashing light signals. The test crossing is frequented by variable-speed trains. Before train predictors were installed, highly variable and long warning times were observed. The studies involved comparing data gathered before and after installation of train predictors at the test crossing. The data included warning times vehicle clearance times (relative to a train's arrival), vehicles crossing, and vehicle speed and deceleration profiles. These data were collected using video camera-recorder systems that were activated automatically whenever a train approached the test crossing. Data were collected for a 2-month period before the train predictors were installed, and for a 2-month period after installation. A total of 139 train movements were observed--89 train movements during the before study and 50 movements during the after study. On the basis of the results of the field studies, the predictor hardware proved to be operationally reliable. Installation of the predictors resulted in more CWTs, a lower mean warning time, and fewer excessively long warning times at the study crossing. Installation of predictors (and the CWT they provide) also improved the overall safety of the study crossing and enhanced driver respect for the flashing light signals. Vehicle clearance times were significantly increased, and risky driver behavior was reduced. Speeds, driver reaction times, and deceleration levels were not influenced adversely.

Larue, Grégoire S.; Blackman, Ross A.; Freeman, James (2020): Frustration at congested railway level crossings: How long before extended closures result in risky behaviours? In: Applied ergonomics 82, S. 102943. DOI: 10.1016/j.apergo.2019.102943.

Abstract: Drivers' non-compliance with rules is a prominent factor in collisions with trains at railway level crossings. Road user impatience and frustration has been identified as an underlying factor in non-compliance and can be characterised as a specific risk factor. However, research on non-compliance related to waiting times and driver inconvenience lacks in the literature. This paper, therefore, seeks to enhance the currently limited understanding of the relationship between waiting times and risky driver behaviour. An Advanced Driving Simulator was used to obtain objective measures of level crossing non-compliance. Subjective measures on driver frustration and decision-making processes were also collected. Sixty participants completed six driving tasks each, with the tasks varying in terms of traffic conditions, number of trains and associated waiting times. This study shows that increased waiting times result in higher levels of frustration and an increased likelihood of risky driving behaviour, particularly for waiting times longer than 3 min. Non-compliance included entering the activated crossing before boom gates are down, entering the crossing after the train passage but before signals are deactivated, stopping/reversing on the crossing. Subjective data revealed that participants did not comply with level crossing rules due to factors including time pressure, impatience/frustration and low perceived risk. The results suggest that, where possible, waiting times should be standardised at values lower than 3 min to reduce the likelihood of risky road user behaviour.

Bowman, B. L. The Effectiveness of Railroad Constant Warning Time Systems. In Transportation Research Record No. 1114, Traffic Control Devices and Rail-Highway Grade Crossings, TRB, National Research Council, Washington, D.C., 1987. pp. 111–122.

Excerpt: Presented in this paper are the results of two tasks of a study sponsored by the Federal Highway Administration. The purpose of these tasks was to determine the effectiveness of railroad constant warning time (CWT) systems in (a) reducing motorists violation of activated at-grade warning systems, and (b) reducing vehicle-train accidents. CWT systems have the capability of measuring train motion, direction of movement, and distance from the crossing. These parameters are interpreted by the control logic to provide estimates of train speed and arrival time. When the estimated arrival time achieves a preselected minimum, such as 20 sec, the warning displays at the crossing are activated. Analysis of operational data indicated that CWT systems are effective in providing both a uniform amount of the advance warning and in reducing motorist violation of the warning system. A comparative analysis of vehicle-train accidents occurring from 1980 through 1984 was also performed. This analysis indicated that, in the majority of cases, crossings with CWT systems have a lower accident rate than crossings without CWT. Nevertheless, this difference was not large enough to be statistically significant at the 95 percent confidence level.

Related Measures

- Automatic gates
- Complete open-close cycle
- Second train warning

Images

- No images available