Measure Name Grade separation

Definition Modify the physical infrastructure around the right-of-way to allow safe passage from one side of the tracks to the other, such as an overpass or underpass.

Tags

Incident Type	Trespass only
Location	Both station and right-of-way
Intervention Strategy	Engineering: technological and physical deterrents
Measure Group	Infrastructure modification

Description

This measure relates to the construction of an underpass or overpass to provide safe passage from one side of the railroad tracks to the other. Providing a different grade level for trains and pedestrians can reduce the possibility of train strikes. These grade-separated crossings are expensive to build and may be underutilized if not properly designed or built.

According to the American Association of State Highway and Transportation Officials (AASHTO) guide for planning, design, and operation of pedestrian facilities, grade-separated crossings should incorporate the following conditions [1, p. 95]:

- The facility is located where it is needed and will be used.
- Crossing structures are built with adequate widths based on perception of safety and pedestrian volumes.
- The design is accessible to all users.
- Barriers/railings are provided to add an increased sense of safety to the pedestrian.
- The facility is well lit, which increases pedestrian security.

This measure is most effective where there is an incentive for pedestrians to cross the tracks, such as a shortcut between residential area on one side and a pedestrian attraction (parking lot, shopping center, schools, parks, etc.) on the other. The addition of high train volume or trains that are known to block crossings for extended periods of time can exacerbate the problem. The likelihood of pedestrians using a grade-separated facility is strongly tied to the time it takes to utilize the grade-separated crossing compared to the time it takes to use an alternate route [2]. In other words, pedestrians tend to use grade-separated paths when it does not significantly lengthen their trip.

An empirical study investigated evaluated the effects of closing and replacing a grade crossing with a vehicular and pedestrian overpass bridge in Alabama. The study showed that after the construction of the overpass, trespassers entering the railroad Right-Of-Way (ROW) increased by 72 percent. However, trespassing while a train was blocking the crossing decreased by 84 percent, and the number of train strikes decreased by 93 percent [3]. The safety of passengers is of utmost importance when closing a grade crossing. When selecting which grade crossing to close, choosing one that is least important for road users, but still has a vital influence on the overall risk of the railway network is a safety improvement strategy [4]. The advantage of shutting down a crossing should be equivalent to the risk of

accidents before it is closed, as it will eliminate the interaction between trains and vehicles on the road [4].

Additional search terms: *at grade, deterrent, overpass, underpass*

Advantages

- This measure is most effective at preventing high-risk trespassers when a train is on the tracks [3].
- A grade-separated crossing can improve operation if the grade separation was constructed by closing an existing at-grade crossing.
- Grade separation can also be used at stations.

Drawbacks

- Grade-separated crossings can be expensive and take a long time to build.
- These areas could become sites of crime and vandalism if not properly located to deter these actions [1].
- Grade-separated crossings may not be used by pedestrians if they appear to be inconvenient for getting to their destinations [1].

Notable Practices

- If the grade separation is built by closing an existing at-grade crossing, ensure that the crossing is properly closed by removing all signs of a crossing and restricting access to railroad ROW by installing a fence. When determining the height of the fencing needed, consider the potential for individuals to jump or climb over the fence [1].
- This measure is most beneficial where trespassing is moderate-to-high, many children are present, there are unacceptable traffic delays due to stopped trains, and when residential neighborhoods are separated from schools by the railroad tracks [1][2].
- Trespass rate (total trespassers divided by total pedestrians entering the railroad ROW) can be collected before and after the construction of grade-separated facilities to measure their effectiveness. Ensure that data before and after construction is collected during the same time of year so the conditions are as similar as possible.
- This measure may be more effective when combined with educational and environmental interventions to inform the public about trespassing risks, such as brochures, presentations, and signage. Findings showed that the proportion of pedestrians who used an overpass bridge to

cross the tracks increased substantially from 41 percent to 60 percent immediately after education and environmental interventions [5].

References

[1] American Association of State Highway and Transportation Officials. (2004). *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* The American Association of State Highway and Transportation Officials.

Document Excerpt: The purpose of this guide is to provide guidance on the planning, design, and operation of pedestrian facilities along streets and highways. Specifically, the guide focuses on identifying effective measures for accommodating pedestrians on public rights-of-way. Appropriate methods for accommodating pedestrians, which vary among roadway and facility types, are described in this guide. The primary audiences for this manual are planners, roadway designers, and transportation engineers, whether at the state or local level, the majority of whom make decisions on a daily basis that affect pedestrians. This guide also recognizes the profound effect that land use planning and site design have on pedestrian mobility and addresses these topics as well. [see Section 4.4 Maintenance of Pedestrian Traffic in Construction Work Zones for relevant information].

[2] Moore, R. and Older, S. (1965). Pedestrian and motor vehicles are compatible in today's world. *Traffic Engineering, 35*(12) 20-23, 52-59.

Description: This book describes a study was conducted in London, England to observe pedestrian use of highway grade separated crossings. A formula was devised where R is equal to the time required to utilize the grade separated crossing divided by the time required to cross at street level.

[3] Ngamdung, T. (2019*). Effect of Grade Separation on Pedestrian Railroad Trespass Activity at Shuttlesworth Drive in Collegeville, AL.* Technical Report No. DOT/FRA/ORD-19/11. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

Abstract: The Volpe Center, under the direction of FRA's Office of Research, Development, and Technology, conducted a research study to evaluate the effects of closing and replacing the Fred L. Shuttlesworth Drive grade crossing (Crossing ID 352514C) with a vehicular and pedestrian overpass bridge on trespassing along a rail corridor in Birmingham, AL. Trespassing events were coded for 10 hours per day for 5 weekdays before construction of the overpass bridge and then again for approximately 5 months after the opening of the overpass bridge.
Results indicate that the rate of trespassers increased by 72 percent, from 44.74 to 76.91 per 100 pedestrians entering the railroad right-of-way, after the construction of the overpass bridge. However, high-risk trespass activities (trespassing during train events and trespassers physically interacting with a train) decreased significantly after the construction of the overpass bridge. Trespassing during train events decreased by 84.3 percent, from 7.05 to 1.10 trespassers per train event, and trespassers physically interacting with a train decreased by 92.6 percent, from 1.62 to 0.12 trespassers per train event after the construction of the overpass bridge.

[4] Qiu, S. (2021). A Risk-Based Decision Support Framework for Railway-Highway Grade Crossing Closures.

Abstract: Reducing the risk of collisions between trains and vehicles at railway-highway grade crossings is a high priority safety strategy set by many governments and railway authorities. To achieve this goal, one of the main engineering approaches used is to permanently close some grade crossings. Although this

approach can completely eliminate the collision risk at the grade crossings being closed, it could have a huge impact on the road traffic, resulting in a significant increase in travel time for road users. This can also lead to some secondary problems, such as increased trespassing risk. Thus, the problem of which crossings should be closed must be addressed with a careful consideration of all benefits and costs that could result from the closure. This research aims to develop a specific framework for determining the priority of grade crossing closure and develop models that can be used to quantify the safety benefit and the costs.

[5] Lobb, B., Harré, N., and Suddendorf, T. (2001). An evaluation of a suburban railway pedestrian crossing safety programme. *Accident Analysis & Prevention. 33*(2) 157-165

Abstract: This study evaluated a programme of educational and environmental (access prevention) interventions designed to reduce the incidence of illegal and unsafe crossing of the rail corridor at a suburban station in Auckland, New Zealand. Immediately after the programme of interventions, the proportion of those crossing the rail corridor by walking across the tracks directly rather than using the nearby overbridge had decreased substantially. Three months later, the decrease was even greater. However, the educational and environmental interventions were introduced simultaneously so that the effects of each could not be separated; nor could other unmeasured factors be ruled out. Anonymous surveys administered immediately before and 3 months after the interventions indicated that while awareness of the illegality of walking across the tracks had increased slightly, perception of risk had not changed. This suggests that the educational interventions may have had less effect than the access prevention measures.

Additional Resources

Toole, J. (2010). *Update of the AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities,* National Cooperative Highway Research Program (NCHRP) Project 20-07.

Description: This document provides and literature review and survey results regarding how to improve the previous version of the AASHTO Pedestrian Guide.

Related Measures

- Collaboration with local government and communities
- Identify funding opportunities
- Incident cost estimation
- Landscaping treatment to restrict access
- Rail safety education in communities
- Right-of-way fencing
- Station design considerations