Measure Name: Rail corridor risk assessment

Definition: Identification of locations with increased risk for grade crossing incidents along a pre-determined railroad corridor.

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

This measure involves identifying high-risk grade crossings along railroad corridors by analyzing past incident history and risk factors that relate to grade crossing incidents. Examples of risk factors include vehicular and pedestrian traffic generators such as nearby businesses and stations, disregard for grade crossing warning signs [1], train frequency, and train speed.

FRA, railroad, state, and local agencies have investigated various methods to analyze risk along a railroad corridor. The U.S. Department of Transportation Accident Prediction and Severity (APS) model maintained by the FRA has been used by Federal, State, and local authorities to assess accident risk at highway-rail grade crossings since the late 1980s [2]. The FRA developed a new model built on the current APS model in 2020 that employs current consensus analysis methods and recent data trends and addresses several limitations of the existing model [3]. Several state agencies have also developed their own models, most of which are based on the APS model [4].

Other methods also exist, including some that can also apply to suicide and trespass. One such method is the location-based, trespass hazard assessment methodology developed by Volpe. The algorithm is derived from a formula developed by the Long Island Rail Road (LIRR). The formula for determining the risk severity for each segment (each grade crossing location and each section of ROW between grade crossings were designated as single segments) in this study was given by [5]: PS = FA(10) + FS(5) + DS(2) + TR

Where,

PS = Priority Score

FA = Fatal Incidents

FS = Fatal Suicides (and attempts)

DS = Debris Strikes

TR = Trespass Reports

Another approach to corridor risk assessment consists of employing frequency calculations, train crew surveys, and geospatial methods to identify areas with the highest risk [6].

A third approach described in an FRA study [7] used video footage to collect data at suspected hotspots to better understand risk. Camera locations were determined based on reported incidents, population density, and environmental factors such as worn footpaths, nearby residences, businesses, and recreational areas that are separated by rail corridors. Although the cameras had motion detection capability, each event was described manually to better understand the risk at each location. The study categorized the types of events that are common at each location, including the number of events, how many individuals were involved, if the individual(s) walked along or across the tracks, and the average time on the ROW for each event. Such information can give a better understanding of the risk present at a specific area.

Additional search terms: *accident prediction, severity, data, hotspot, locality, place, point*

Advantages

- Rail corridor risk assessment analyzes each section of an entire rail corridor for high-risk locations. It includes areas where incidents have already occurred, but this is not a requirement.
- This measure help focus mitigation strategies on high-risk locations and allocate resources effectively.

Drawbacks

- Some relevant data may be highly sensitive, such as close calls and observations that did not turn into incidents. Stakeholders generally do not share this kind of information without collaboration.
- The close-call data collected through train crew observation or via Forward Facing Closed Circuit Television (FFCCTV) only captures activities during train operation. However, this represents only a fraction of the total close-call activity along a corridor.
- Incorporating other risk factors into identifying high-risk locations can be more costly and time consuming than other types of risk assessment, such as identifying existing hotspots.
- Detailed suicide data is removed from publicly available FRA data, potentially limiting the utility of the dataset for overall risk assessment.
- It may be challenging to identify the specific motivations of the individuals involved in grade crossing incidents from available aggregate data. Seeking out additional data sources to identify common motivations may be necessary to form a more complete picture of risk [7].

Notable Practices

- Include close-call data in risk assessment, if available. Close-call information may rely on the Confidential Close Call Reporting System (C^3RS) or internal railroad data collection due to privacy and other legal considerations.
- If historical grade crossing data are included in the risk assessment, the FRA Highway/Rail Grade Crossing Incidents Dashboard is a publicly available resource for data starting from 1975 (see Additional Resources).
- Train frequency and train speed for a rail segments can be obtained by identifying the nearest grade crossing on the same rail corridor and by obtaining inventory data from the FRA Grade Crossing Inventory database.
- Train crews could be surveyed to gather information about grade crossing and trespass activities along the corridor. In one FRA study [6], a graph showing the milepost of the corridor was provided to train crews; they were asked to rate trespass activities from zero to five, with zero representing no observed activity and five representing extremely frequent trespass activity.

- If assessing specific locations in detail, consider how certain attractions may impact grade crossing incident and trespass rates differently throughout the year [7]. For example, activity near a university may increase during the school year or during sporting events both with road traffic though crossings and foot traffic.
- Consider the time it would take to segment the rail corridor and enter the relevant inventory of factors for each segment.
- Segment the rail network into appropriate distances depending on system-specific circumstances.
    - The LIRR Hazardous Assessment Approach to Trespass Management—High Security Fencing [8] divided a 95-mile section of the track into 4 miles segments.
    - One FRA study [5] designated each grade crossing location and each section of ROW between grade crossings as single segments.
    - Another FRA study [6] divided the corridor between Raleigh to Charlotte into 1-mile segments based on milepost. From this starting point, 3-, 5-, and 10-mile windows were used to aggregate the segment data into community or regional groups.
- The following formula [5] may be used for determining the risk severity for each segment: PS = FA(10) + FS(5) + DS(2) + TR

    Where,

    PS = Priority Score
    FA = Fatal Incidents
    FS = Fatal Suicides (and attempts)
    DS = Debris Strikes
    TR = Trespass Reports

References

[1] Stanchak, K. and DaSilva, M. (2014). *Trespass Event Risk Factors*. Technical Report No. DOT/FRA/ORD-14/32. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

Abstract: The Volpe Center has used three sources of data—the Federal Railroad Administration’s required accident reports, locomotive video, and U.S. Census data—to investigate common risk factors for railroad trespassing incidents, the leading cause of rail related deaths in the U.S. Risk factors found include (1) a disregard for grade crossing warning signs, (2) trespasser intoxication, (3) use of distracting electronic devices, and (4) right-of-way proximity to stations, bridges, and rail yards. This research report offers several suggestions for improved data availability to support future studies.

[2] FRA Office of Safety Analysis – Website

Excerpt: This site was established for the purpose of making railroad safety information readily available to a broad constituency which includes FRA personnel, railroad companies, research and planning organizations and the public, in general. Visitors have access to railroad safety information including accidents and incidents and highway-rail crossing data. From this site users can run dynamic queries and view current statistical information on railroad safety.

[3] Federal Railroad Administration. (2020). New Model for Highway-Rail Grade Crossing Accident Prediction and Severity.

> Abstract: The U.S. Department of Transportation Accident Prediction and Severity (APS) model has been used by Federal, State, and local authorities to assess accident risk at highway-rail grade crossings since the late 1980s. The Federal Railroad Administration funded research for the development of a new model that employs current consensus analysis methods and recent data trends. The new model also seeks to address several limitations of the current APS model and to provide a more robust tool for analysts.
>
> This report presents the stages of the new model development, the statistical estimation of the new model, and validations comparing the performance of the new model with the APS. The research shows that the new model described here out-performs the APS by multiple measures.
>
> The new model will support grade crossing management by enabling: more accurate risk ranking of grade crossings, more rational allocation of resources for public safety improvements at grade crossings, and the ability to assess the statistical significance of variances in the measured risk at grade crossings.

[4] Sperry, B., Naik, B., and Warner, J. (2016). Evaluation of Grade Crossing Hazard Ranking Models. Technical Report, FHWA/OH-2016/10. Ohio Department of Transportation.

> Abstract: Public agencies involved with highway-railroad grade crossing safety must allocate available funding to projects which are considered the most in need for improvements. Mathematical models provide a ranking of hazard risk at crossings and support the project selection process. The goal of this research study was to provide ODOT, the ORDC, the PUCO, and other stakeholders with a better understanding of the grade crossing hazard ranking formulas and other methods used by States to evaluate grade crossing hazards and select locations for hazard elimination projects. A comprehensive literature review, along with interviews of state DOT personnel from eight states yielded best practices for hazard ranking and project selection. Detailed evaluation of several different hazard ranking models determined that the existing hazard ranking model used in Ohio, the U.S. DOT Accident Prediction Model, should continue to be used. The research team also recommends greater use of sight distance information at crossings and expanding the preliminary list of crossings to be considered in the annual program as enhancements to the existing project selection process used by the ORDC and ODOT.

[5] DaSilva, M. and Ngamdung, T. (2014). *Trespass Prevention Research Study – West Palm Beach, FL*. Technical Report No. DOT/FRA/ORD-14/19. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

> Abstract: The United States Department of Transportation's (U.S. DOT) Research and Innovative Technology Administration's John A. Volpe National Transportation Systems Center (Volpe Center), under the direction of the U.S. DOT Federal Railroad Administration's (FRA) Office of Research and Development (R&D), conducted a Trespass Prevention Research Study (TPRS) in the city of West Palm Beach, FL. The main objective of this research was to demonstrate potential benefits, including best practices and lessons learned, of implementation and evaluation of trespass prevention strategies following FRA's and Transport Canada's existing trespassing prevention guidance on the rail network in West Palm Beach, FL, and all of its rights-of-way.
>
> This report documents the results of the implementation of the guidance discussed in this study. The results of the trespass prevention strategies will be analyzed to help determine areas of potential risk, develop solutions to prevent and minimize risk exposure, and implement successful countermeasures in

the future. The ultimate objective of the research is to aid in the development of national recommendations or guidelines to reduce trespass-related incidents and fatalities.

[6] Cunningham, C., Vaughan, C., Searcy, S., Aghdashi, B., Lu, G., Horne, D., and Maychak, N. (2016). Reduction in Railroad Right-of-Way Trespassing Incidents. Technical Report, FHWA/NC/2015-18. Raleigh, NC: North Carolina Department of Transportation.

Abstract: This research analyzed Federal Railroad Administration (FRA)-reported trespassing events along the North Carolina Railroad (NCRR) between Raleigh and Charlotte, NC using rate calculation, train crew surveys, and geospatial methods to identify communities with the highest risk of railroad right-of-way trespass. Since the FRA started geolocating trespass data in July 2011 through June 2016, this corridor had 65 reported trespasser strikes, or an average of one strike for every 677 trains. Based on an analysis of historic trespass strike data, associated environmental features, and survey data provided by train crews who travel along the portion of the NCRR under study, the communities with the highest trespass risk are Durham, Mebane, Elon/Burlington, and Greensboro. The rate of strikes from the 5 year study period indicates that these communities have the highest risk corridors. The close proximity of pedestrian generators to the railroad in these areas shows some correlation to the high number of strikes.

[7] Searcy, S., Vaughan, C., Coble, D., Poslusny, J., & Cunningham, C. (2020). *Rail Network Trespass Statewide Severity Assessment and Predictive Modeling*. FHWA/NC/2019-08

Abstract: The Institute for Transportation Research and Education (ITRE) at NC State University in collaboration with the North Carolina Department of Transportation (NCDOT) has conducted research to develop a more complete understanding of the extent of pedestrian trespassing along the rail network in North Carolina. This research seeks to better quantify and describe the universe of trespassing activities including those events that do not result in injury or death through the development and testing of static (fixed base) thermal camera systems. Thermal camera systems were deployed at a sample of trespassing hot spots along railroad corridors in North Carolina to determine a count of trespassing events for the data collection time periods and an estimate of the trespassing frequency at the hot spots. Using these trespassing event data, models for estimating and predicting trespassing across the rail network were developed. The data were also used to develop profiles of trespassing activity by season of year, month of year, day of week, and hour of day for each hot spot location that can inform local-level intervention strategies.

[8] Long Island Rail Road (n.d.). *Hazardous Assessment Approach to Trespass Management – High Security Fence.* [Slides].

Description: Presentation describes an algorithm used for prioritizing the implementation of high security fencing.

Additional Resources

FRA Office of Safety Data – Website

Description: FRA database that contain railroad safety information including accidents and incidents, inventory and highway-rail crossing data.

FRA Highway/Rail Grade Crossing Incident Dashboard – Website

Description: Presents interactive grade crossing incident data, including a map of incidents across the United States. This website allows users to view data in multiple forms, including location, crossing type, vehicle type, type of highway user, user action, and more.

Federal Railroad Administration. (2012). Grade Crossing Evaluation Tools and Risk Assessment.

Excerpt: FRA develops tools to assist agencies, analysts and policymakers in assessing safety risks and potential changes to highway-rail grade crossings. FRA has developed a GIS grade crossing viewer, a crossing improvement decision tool, and is working on a risk assessment methodology for high-speed grade crossings.

Confidential Close Call Reporting System (3CRS) – Website

Description: The Confidential Close Call Reporting System (C3RS) is a partnership between the National Aeronautics and Space Administration (NASA), the Federal Railroad Administration (FRA), in conjunction with participating railroad carriers and labor organizations. The program is designed to improve railroad safety by collecting and analyzing reports which describe unsafe conditions and events in the railroad industry. Employees will be able to report safety issues or “close calls” voluntarily and confidentially.

National Atlas Transportation Database (NTAD)

Description: The NTAD contain geographic datasets representing the United States’ transportation infrastructure, containing roadways, railways, waterways, and airports. Bureau of Transportation Statistics (BTS) publishes the datasets every year.

ESRI Data and Maps

Description: This website contains a collection of data layers for the United States, Europe, and the world. There is commercial data from TomTom, Michael Bauer Research, Garmin, and Esri; and federal data from the U.S. Census, The National Map Small Scale (formerly National Atlas of the United States), U.S. Geological Survey, and the U.S. Geographic Names Information System (GNIS). The data layer in this group is available for download or can be used in ArcGIS 10.4 or later.

Related Measures

- Identify and monitor hotspots
- Risk assessment using CCTV

Images

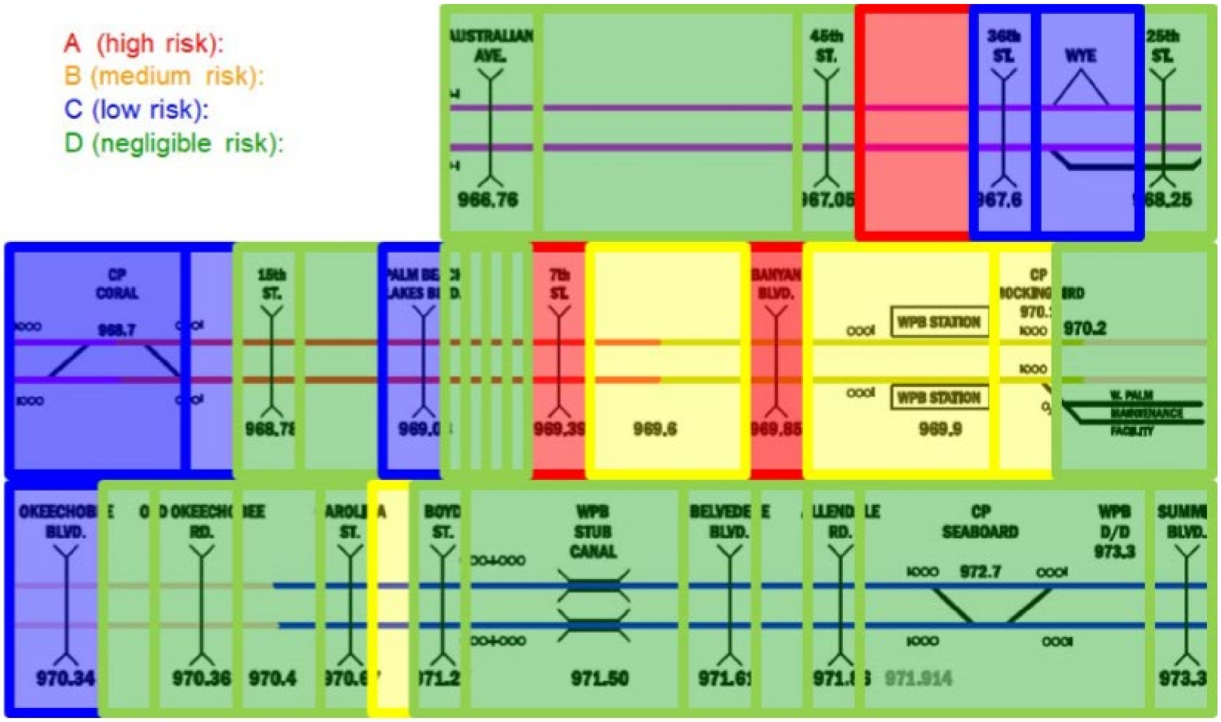

Figure 1. Example of rail corridor risk assessment from West Palm Beach, FL
Image Credit: Volpe Center