Measure Name Rail corridor risk assessment

Definition Identification of locations with increased risk for trespass along a pre-determined railroad corridor.

Tags

Incident Type	Both trespass and suicide
Location	Both station and right-of-way
Intervention Strategy	Data: application and planning
Measure Group	Risk assessment

Description

This measure involves identifying high-risk areas along railroad corridors by analyzing trespass and suicide incident data and relevant risk factors. Examples of risk factors include nearby businesses that are separated from neighborhoods by railroad tracks that encourage shortcutting, train frequency, and trespass occurrence (without incident).

The United States rail network consist of about 155,000 miles of operating routes [1]; therefore, it is crucial to identify high-risk areas and prioritize the available resources for trespass and suicide prevention. Currently, casualties, and close-calls observed by train crews and past incidents are used to select high-risk areas for trespass mitigations. However, this excludes locations that have not yet experienced an incident from consideration for prevention and mitigation efforts.

FRA, railroad, state, and local agencies have investigated various methods to analyze risk along a railroad corridor and can apply to both 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 right-of-way (ROW) between grade crossings were designated as single segments) in this study was given by [2]: 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

A second approach to corridor risk assessment consists of employing trespass frequency calculations, train crew surveys, and geospatial methods to identify communities with the highest risk of trespass [3].

A third approach described in an FRA study [4] 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: *analysis, data, hotspots*

Advantages

- Rail corridor risk assessment analyzes each section of an entire rail corridor for high-risk locations. It includes areas where trespass or suicide 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 trespasser observations that did not result in an incident. 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 trespass 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 risk assessment.
- It may be challenging to identify specific reasons for trespassing based on aggregate data. Seeking out additional data sources, such as interviewing trespassers, to identify common motivations may be necessary to form a more complete picture of trespass risk [4].

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 trespass and suicide data are included in the risk assessment, the FRA Safety Data & Reporting website is a publicly available resource for data starting from June 2011 (see Additional Resources).
- Train frequency and train speed for a rail segment 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.
- Consider analyzing a variety of factors relevant to trespass incidents. This includes train frequency, train speed, population density, proximity of the ROW to areas with foot traffic, proximity to crossings, etc. [5][6][7].
- Train crews could be surveyed to gather information about trespass activities along the corridor. In one FRA study [3], 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 trespass locations in detail, consider how certain attractions may impact trespass rates differently throughout the year [4]. For example, trespassing activity near a university may increase during the school year or during sporting events.
- 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 95 mile section of the track into 4 miles segments.
    - One FRA study [2] designated each grade crossing location and each section of ROW between grade crossings as single segments.
    - Another FRA study [3] 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 [2] 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] Oswald Beiler, M. R., Miller, G., & Varley, D. (2018). Railway Trespass Prevention: Spatial Analysis of Incidents to Connect to Countermeasures. *Journal of Transportation Engineering, Part A: Systems*, *145*(2).

Abstract: Railway incidents continue to be a safety concern for transportation agencies throughout the United States. In particular, trespasser incidents, which are the most frequent cause of railway fatalities in the United States, are those that involve a person whose presence is prohibited or actions are unlawful involving railway property. By analyzing past data on trespassing incidents, recommendations for future improvement through countermeasures can be made. This research investigates historical trespasser incidents throughout national Amtrak data from 2011–2017. The data were analyzed at the national as well as megaregional levels in order to determine trends using 14 factors, including both incident (such as time of day, precrash activity, and gender) as well as geographic (such as population density and average income based on the census level in which the incident occurred) factors. A case study on a segment of Amtrak's northeast corridor alignment is provided in order to serve as an example of connecting to countermeasure recommendations.

[2] 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.

[3] 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.

[4] 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.

[5] 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.

[6] Federal Railroad Administration. (2018). *Report to Congress National Strategy to Prevent Trespassing on Railroad Property*.

Description: This report is in response to U.S. House of Representatives Committee on Appropriations request for FRA to study and identify the causal factors that lead to trespassing incidents on railroad property. The report defined four strategic areas for its national strategy; Data Gathering and Analysis, Community Site Visits, Funding, and Partnerships with Stakeholders. The report list top 10 counties in the United States where most pedestrian trespasser casualties occurred between November 2013 and October 2017. The report also analyzed trespass incident in relation to its distance from a grade crossing. The finding showed that approximately 73 percent of trespassing suicides and attempted suicide casualties and 74 percent of trespassing casualties excluding suicides occur within 1,000 feet (less than ¼ of 1 mile) of a highway-rail grade crossing.

[7] Kang, Y., Iranitalab, A., & Khattak, A. (2019). Modeling railroad trespassing crash frequency using a mixed-effects negative binomial model. *International Journal of Rail Transportation*, *7*(3), 208-218.

Abstract: A better understanding of rail trespass crashes is needed as more than 400 trespassing related fatalities occur along rail tracks each year in the United States (U.S.). The objective of this research was to investigate factors associated with the occurrence of rail trespass crashes. Yearly crash frequency for counties in the U.S. with train tracks was modeled using a Mixed-effects Negative Binomial Model based on 2012–2016 datasets from the Federal Railroad Administration, the U.S. Census Bureau and National Historical Geographic Information System. Results revealed that key factors affecting rail trespassing crashes include county population density, length of rail tracks in a county, median age and male proportion of the county population, and average train traffic within a county. The findings provided useful information on improving public safety along railroad tracks.

[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

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.

Data.Transportation.gov

Description: The U.S. Department of Transportation public data portal that provides a variety of data across all transportation modes, including rail and public transit.

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

- Collaboration with local government and communities
- Identify access points for potential trespassers
- Identify and monitor hotspots
- Identify funding opportunities
- Improved data collection after an incident
- Incident cost estimation
- Lighting at hotspots
- Risk assessment using forward facing CCTV