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13. ABSTRACT (Maximum 200 words)
The U.S. Department of Transportation's (DOT) John A. Volpe National Transportation Systems Center (Volpe Center), under the direction of DOT's Federal Railroad Administration Office of Research, Development and Technology, conducted a research study that evaluated the effectiveness of anti-trespass guard panels installed on a railroad right-of-way (ROW) adjacent to the West Dickson Street grade crossing in Fayetteville, AR. The goal of the panels was to reduce the number of pedestrians that trespass onto railroad ROWs.
Data was collected over 10 weekends before and another period of 10 weekends after the installation of the anti-trespass guard panels. Results indicated that the number of trespassing pedestrians was reduced by 38 percent, from 166 trespassers before installation to 103 after installation. Though these results seemed to indicate that this safety enhancement was effective in improving pedestrian behavior, it is important to note that no measure of pedestrian traffic was collected and this safety enhancement has only been studied at one unique crossing. Additional field testing is necessary before recommendations for wider use can be made.

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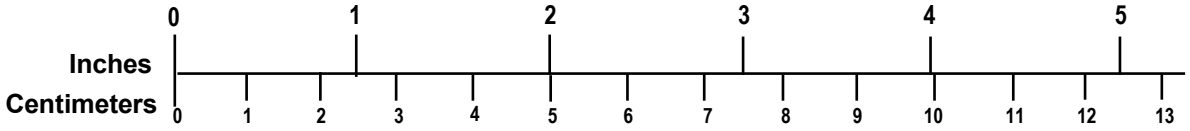

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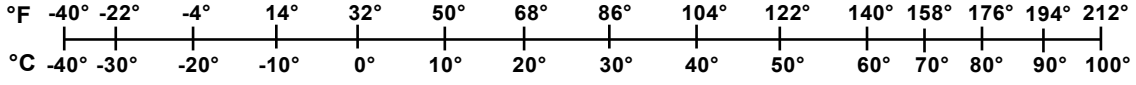

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The authors would also like to thank Kim Carder and Glen Rhodes, Arkansas and Missouri Railroad, Kurt Anderson, Senior Vice President, CTC, Inc., Michail Grizkewitsch, FRA, and Scott Gabree, Surface Transportation Human Factors Division, DOT Volpe Center for their part in supporting this evaluation effort.

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Executive Summary

The John A. Volpe National Transportation Systems Center (Volpe Center) was tasked by the Federal Railroad Administration Office of Research, Development, and Technology with evaluating the effectiveness of anti-trespass guard panels to deter pedestrians from accessing the railroad right-of-way (ROW). The goal of the panels was to reduce the number of people that trespass on railroad ROW from a crossing. The panels were installed at an entrance to the rail ROW at the West Dickson Street crossing (ID 667195J) in Fayetteville, AR as part of safety improvement efforts being conducted by Arkansas and Missouri Railroad.

To evaluate the effectiveness of the anti-trespass guard panels on pedestrian behavior, Volpe Center researchers coded video data of pedestrian actions at the West Dickson Street crossing before and after the installation. They collected the data 24 hours per day for 10 weekends, starting in October 2014 before the installation; they collected the same amount of data approximately 3 months after the installation, starting in September 2015. In total, researchers collected and analyzed 60 days of video data (30 days before and 30 days after anti-trespass guard panels installation) to evaluate the effectiveness of the panels on pedestrian behavior.

The analysis showed that the anti-trespass guard panels were effective in reducing the number of pedestrians who trespassed onto railroad ROW. The number of trespassing pedestrians was reduced by 38 percent, from 166 before the installation of the anti-trespass guard panels to 103 after the installation.

Though these results seemed to indicate that this safety enhancement was effective in improving pedestrian behavior, it is important to note that no measure of pedestrian traffic was collected, and this safety enhancement has only been studied at one unique crossing. Additional field testing and analysis is necessary before recommendations for wider use can be made.

1. Introduction

The John A. Volpe National Transportation Systems Center (Volpe Center) provides technical support to the Federal Railroad Administration (FRA) on all aspect of grade crossing safety and trespass prevention research. This support includes key research associated with all aspects of railroad rights-of-way (ROW), including highway-rail intersections (HRI) and trespass issues.

In 2015, there were 751 rail-related fatalities in the U.S. Approximately 92 percent resulted from grade crossing collisions and trespass incidents. Of the 751 fatalities, 236 resulted from grade crossing collisions and 452 resulted from trespass incidents [1]. This does not include suicide fatalities.

The Volpe Center was tasked by the FRA Office of Research, Development and Technology with evaluating the effectiveness of anti-trespass guard panels to deter pedestrians from accessing railroad ROWs. The goal of the anti-trespass guard panels was to reduce the number of people that trespass on railroad ROW from a crossing. The panels were installed at an entrance to a rail ROW at the West Dickson Street crossing (ID 667195J) in Fayetteville, AR as part of safety improvement efforts being conducted by the Arkansas and Missouri Railroad (A&M).

1.1 Background

Trespass fatalities surpassed grade crossing fatalities in 1997, and since then trespassing has been the leading cause of rail-related deaths. FRA, in partnership with state and local governments, railroad industries, and other organizations, works across the three E's (Engineering, Enforcement, and Education) to improve safety along rail ROWs. This project is one such example of collaboration between FRA, railroads (A&M), and industry (CTC, Inc.) to implement and evaluate an engineering mitigation strategy to reduce trespassing on rail ROW. The Volpe Center, at the request of FRA, participated in this pilot study to evaluate the effectiveness of anti-trespass guard panels in reducing the number of pedestrians who trespass on rail ROWs from a crossing.

A&M identified several trespass problem areas where the railroad wanted to test the panels. The Volpe Center installed video data collection systems and motion sensor cameras to document the problem at these locations. Two video data collection systems were installed at the West Dickson Street crossing to monitor both north- and south-side approaches, and motion-activated cameras were installed at the entrance to the Winslow Tunnel in Winslow, AR and Van Buren Bridge in Van Buren, AR. According to the data, a total of 71 individual trespassers were documented on the south side of West Dickson Street crossing during a 10-day period, a total of 3 individual trespassers on the north side of West Dickson Street crossing during a 7-day period, a total of 25 individual trespassers at the Winslow Tunnel during a 21-day period, and a total of 6 individual trespassers at the Van Buren Bridge during a 9-day period. Based on the results, A&M decided to install anti-trespass guard panels adjacent to the West Dickson Street crossing on the south side. The goal of the anti-trespass guard panels is to physically and visually help deter pedestrians from trespassing onto the railroad ROW.

1.2 Objectives

The objective of this research was to determine the effectiveness of the anti-trespass guard panels in reducing the number of pedestrians who trespass onto rail ROW from a crossing.

1.3 Overall Approach

To evaluate the effectiveness of the anti-trespass guard panels on pedestrian behavior, researchers coded video data of pedestrian actions at the West Dickson Street crossing before and after the installation. The data was collected 24 hours per day for 10 weekends, starting in October 2014 before the installation; the same amount of data was collected approximately 3 months after the installation, starting in September 2015. In total, researchers collected and analyzed 60 days of video data (30 days before and 30 days after installation) to evaluate the effectiveness of the panels on pedestrian behavior.

1.4 Scope

This study investigated the effectiveness of anti-trespass guard panels in reducing the number of pedestrians who trespass onto rail ROW from a crossing. This study was limited to a railroad ROW adjacent to a West Dickson street crossing in Fayetteville, AR (ID 667195J).

1.5 Organization of the Report

This report is organized as follows:

- Section 2 provides an information about the anti-trespass guard panels.
- Section 3 provides an overview of the test site location and data collection activities.
- Section 4 describes the analyses.
- Section 5 presents the results of the study.
- Section 6 presents a summary of the findings.
- Section 7 presents the conclusions of the study.

2. Anti-Trespass Guard Panels

To prevent trespassing on ROWs, the safety measure chosen for evaluation consisted of a device installed adjacent to a highway-rail grade crossing to make it visually and physically difficult to walk on. They are commonly referred to as anti-trespass guards in U.S. or cattle-cum-trespass guards in Europe.

This type of safety treatment is widely used in Europe as an additional safety measure to prevent pedestrians and livestock from trespassing onto ROWs. In the U.K., the Office of Rail Regulation provides guidance on the installation of cattle-cum-trespass guards on "all types of crossings on third rail electrified railways, and where there is movement of animals over the crossing, or where there is a significant risk of trespass by pedestrians" [2]. In United States, this type of safety treatment has been used exclusively at crossings on third rail electrified territory. But recently, similar treatment involving jagged-edge rocks has been used at several crossings adjacent to a station to prevent pedestrians from using the ROW as a shortcut to a station. Figure 1 shows the installation of a rock treatment at the Howard Avenue grade crossing in Burlingame, CA on a Caltrans rail line and Figure 2 shows the installation of triangular section timbers installed at the North Sacramento Avenue grade crossing in Chicago, IL on the electrified CTA Brown Line.

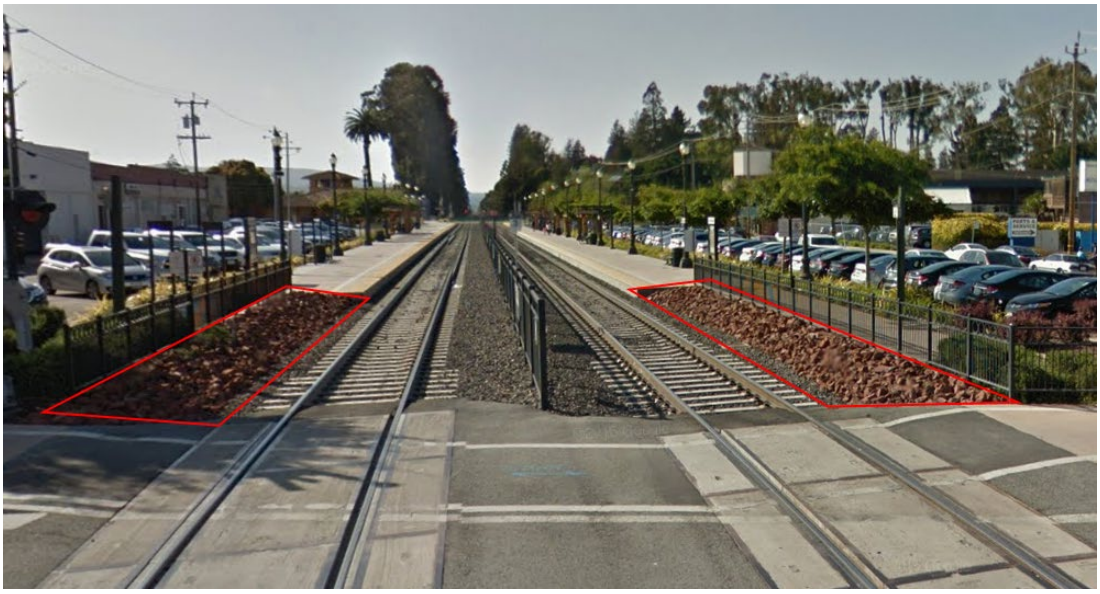

Figure 1. Howard Avenue Grade Crossing, Burlingame, CA

Figure 2. North Sacramento Avenue Grade Crossing, Chicago, IL

2.1 Anti-Trespass Guard Panels for Current Study

The anti-trespass guard panels chosen by A&M for this study were manufactured by Rosehill Rail in the U.K. The treatment consists of panels with a raised pyramidal design installed adjacent to and between the rails at a highway-rail grade crossing. The panels are manufactured from 100 percent recycled rubber and come in three different types: the double-flange standard panel, single-flange panel, and flangeless flat panel. The double-flange standard panel is approximately 1,435 mm by 1,300 mm in size and intended for use between the rails with four foot gauge, the single flange panel is approximately 1,490 mm by 1,300 mm in size and typically used outside the rail, and the flangeless flat panel is approximately 1,490 mm by 1,300 mm in size and used at wider-area highway-rail grade crossings. They are installed using the supplied fixing kits, consisting of two plastic planks and eight screw fixings. The planks are placed under the edge of the panels and secured in place using the washers and screws.

For this implementation, the entire ROW width between the Frisco Trail fence and Majestic Bar patio on the south side of the West Dickson Street crossing were fitted with anti-trespass guard panels. The panels were approximately 8.5 feet deep and consisted of two double-flange standard panels and seven flangeless flat panels. The double-flange standard panels were used between the rails and the flangeless Flat panel were used to cover the area outside the rails. The schematic in Figure 3 shows the installation drawing of the panels at the crossing.

The anti-trespass guard panels were installed on June 2, 2015 by A&M personnel. Figure 4 shows an image of the anti-trespass guard after installation.

In addition to the panels, there was an existing sign mounted to the fence adjacent to the crossing. The sign, which can be seen in the Figure 5, reads “TRESPASSING UPON RAILROAD TRACKS IS ILLEGAL AND DANGEROUS. STAY ON TRAIL.”

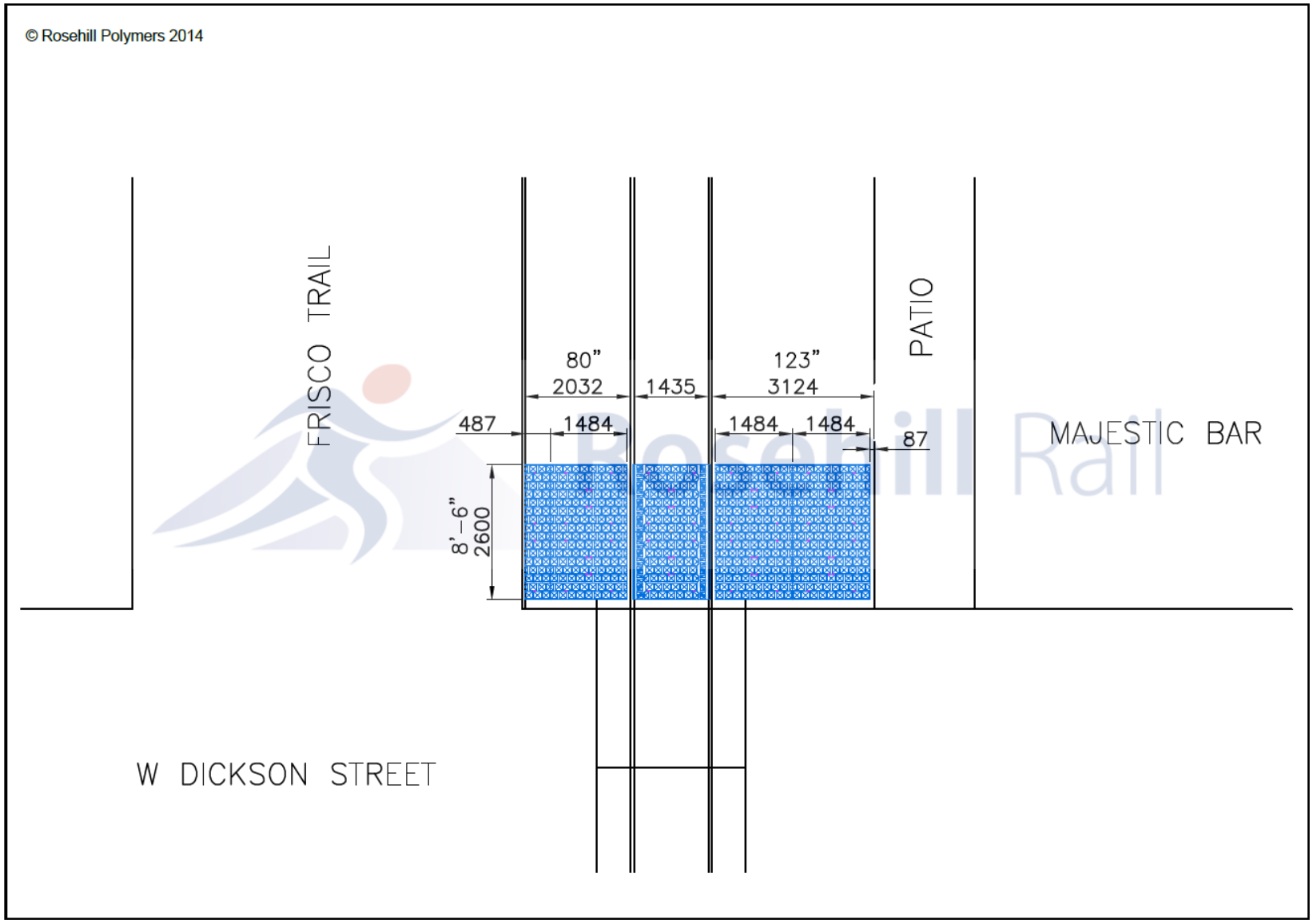

Figure 3. Schematic of Anti-Trespass Guard at West Dickson Street Grade Crossing

Figure 4. Anti-Trespass Guard at West Dickson Street Grade Crossing

Figure 5. No Trespassing Signage at West Dickson Street Grade Crossing

3. Test Site Location and Data Collection

The site chosen by A&M Railroad for this effort was a railroad ROW adjacent to a West Dickson street crossing in Fayetteville, AR (ID 667195J).

3.1 Test Site Location Characteristics

3.1.1 Fayetteville, AR

Fayetteville, AR is located in Washington County, approximately 190 miles from Little Rock in the northwest corner of the state. It is home to the University of Arkansas. The city had a population of 73,580, according to the 2010 census. However, during football game days and other school sporting events, thousands of alumni and fans visit the city. The train line through Fayetteville is composed of a single-line track owned and operated by A&M. It operates both freight and excursion rail service through the city. Figure 6 shows a satellite image of the downtown area; the red X on the image indicates the location of the West Dickson Street crossing.

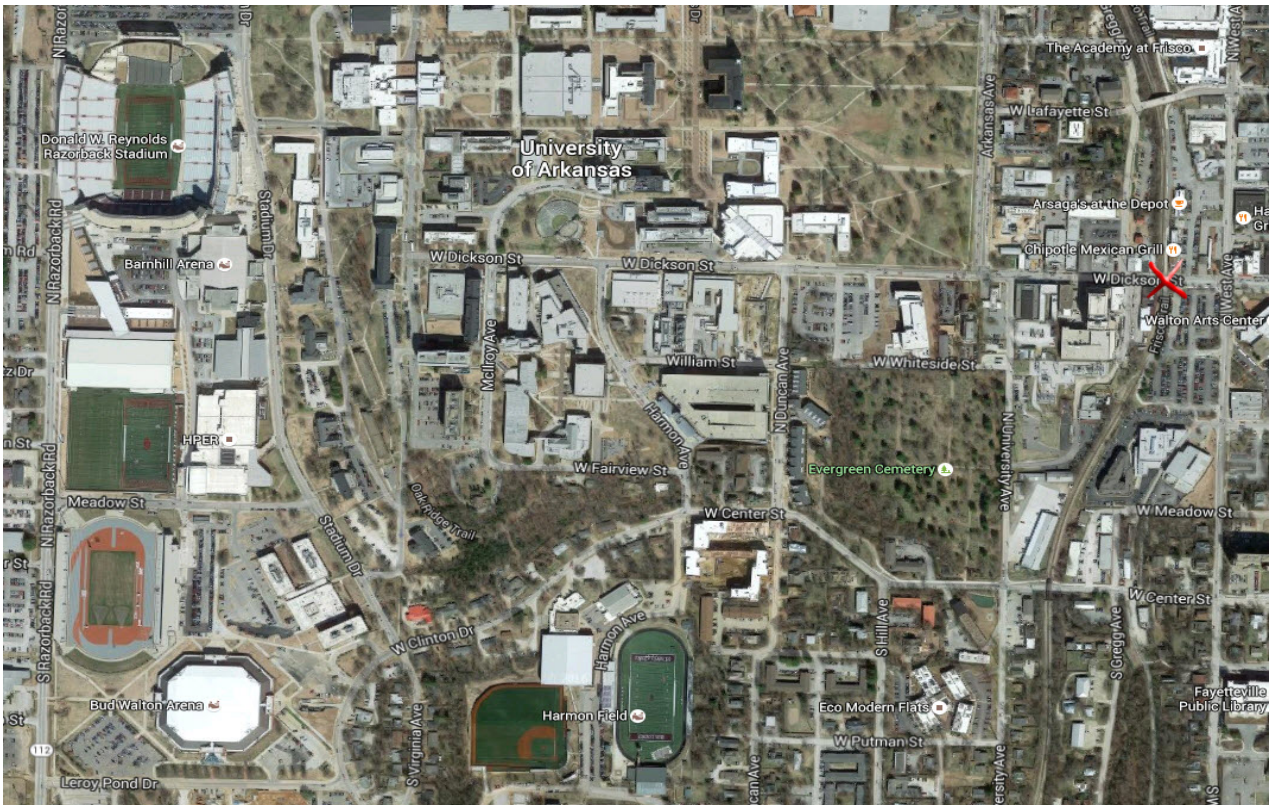

Figure 6. Aerial View of the City of Fayetteville, AR

3.1.2 West Dickson Street Crossing

Dickson Street is Fayetteville's primary entertainment district, with shops, restaurant, and bars lining street. The West Dickson Street crossing is located at milepost 0352.50. There is one

active railroad track that intersects West Dickson Street, and it runs north-south. According to the DOT Highway-Rail Grade Crossing Inventory database, approximately four trains move through the crossing per day at speeds ranging from 5 to 10 mph. The estimated annual average daily traffic (AADT) at this crossing in 1987 was 12,800. Although no pedestrian traffic count was available, the crossing does have heavy pedestrian traffic volume. The crossing was equipped with crossbucks and flashing lights, but during study period in September 11, 2015, the warning devices were upgraded and subsequently equipped with four pedestrian gates (one per quadrant) and two vehicular gates. Figure 7 shows a close-up satellite image of the crossing.

Figure 7. West Dickson Street Grade Crossing Satellite Image

3.1.3 North Side of Crossing

The east side of the track on the north side of the crossing is fenced off and is bordered by Frisco Trail, which runs parallel to the track in this area. It is a paved rail-with-trail, accessible to pedestrians, bicyclists, and wheelchair users. There are a few restaurants adjacent to the trail near the crossing. The west side of the track on the north side of the crossing is bordered by a restaurant building and is fenced-off immediately after the restaurant building. Figure 8 shows a northbound view from the crossing.

Figure 8. View of the Northbound Railroad ROW

3.1.4 South Side of Crossing

There is one lane of traffic and a sidewalk that intersect with the crossing. The east side of the track on the south side of the crossing is fenced off and is bordered by the Frisco Trail, which runs parallel to the track in this area. There is also a large parking lot adjacent to the trail. On the west side of the track on the south side of the crossing, the ROW is bordered by the Majestic Lounge (a music venue and lounge) followed by a couple of restaurants. The lounge is a popular destination in the area for live music and nightlife. The lounge has open patio facing the track. Although the patio is fenced off, the research team noticed many instances where patrons would access the venue by walking onto the ROW and climbing over the patio fence. There is also a parking garage and many restaurants approximately 400 feet away on the south side of the crossing. Figure 9 shows a pedestrian trespassing on the railroad ROW in the south side of the crossing.

Figure 9. Example of Pedestrian Trespassing on Southbound Railroad ROW

3.2 Data Collection Equipment

Pedestrian movements around the crossing were collected using a video camera mounted high up on a railroad pole located on north side of the crossing. The video-based data collection system was installed on September 23, 2014 and remained operational through December 30, 2015. The system consisted of a camera mounted on the pole and a utility box at the bottom of the pole that housed the digital video recorder, temperature switch, fan, and AC power outlet (AC power was obtained from railroad signal system power). Figure 10 shows the video data collection system as installed at the crossing.

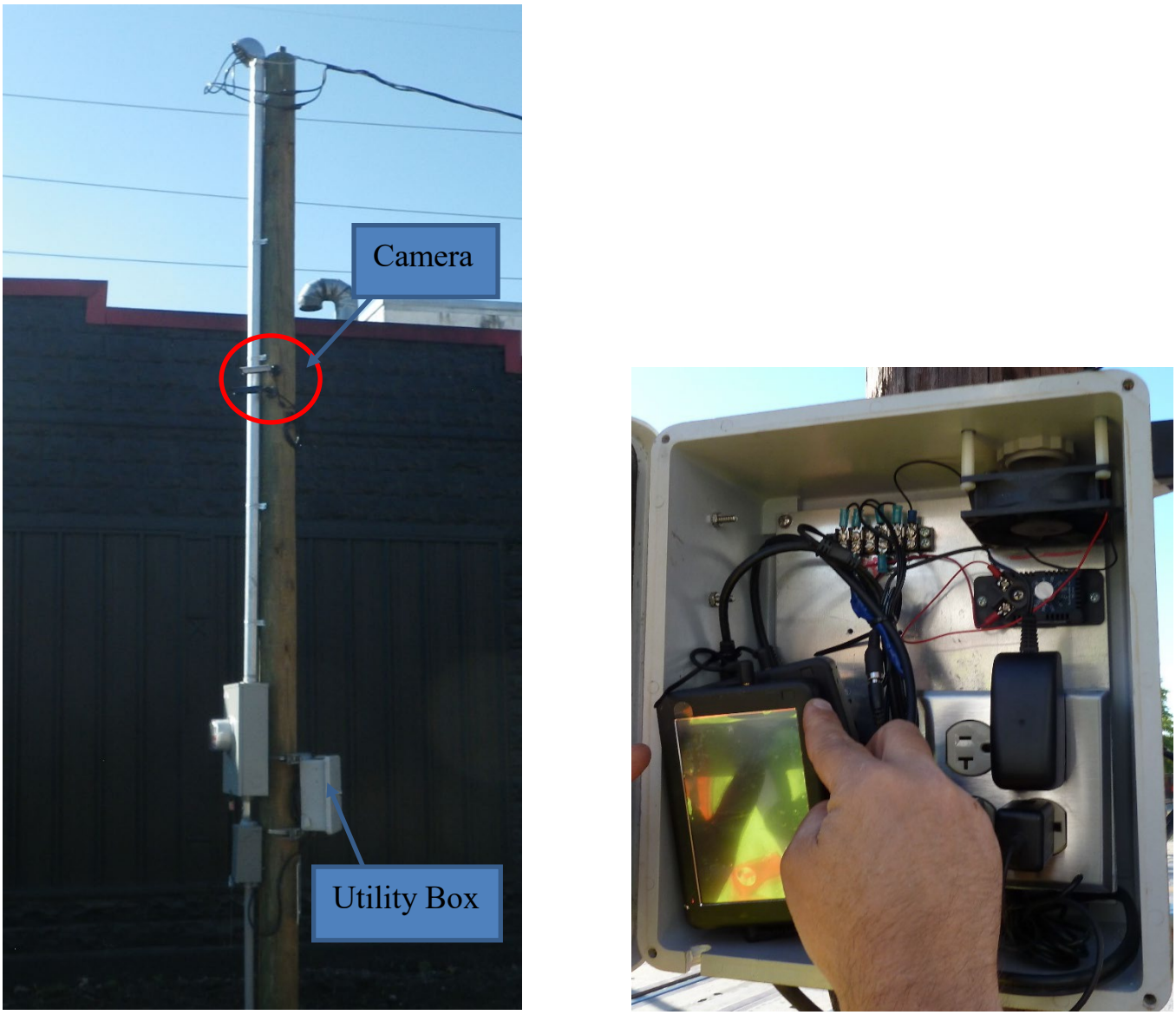

Figure 10. Video Data Collection System

4. Data Analysis Method

To evaluate the effectiveness of the anti-trespass guard panels on pedestrian behavior at the West Dickson Street crossing, pedestrian movement information was collected 24 hours per day for 10 weekends (Friday-Sunday; 30 days) before installation and then again approximately 3 months after the installation. Data was collected throughout the week but only weekend (Friday-Sunday) data was analyzed due to the increase number of pedestrians at the crossing during those periods. The baseline (pre-installation) data was collected between October 10, 2014 and December 21, 2014. The anti-trespass guard panels were installed on June 2, 2015 and the post-installation data was collected between September 4, 2015 and December 20, 2015. Both the pre and post-installation data was collected from September to December because of the college football season. As discussed earlier, the crossing is in close proximity to the University of Arkansas football stadium, so there was a large increase in pedestrian traffic during home games. The research team made sure there were the same number of home and away football games during both the pre- and post-installation periods. Table 1 shows the project phase schedule for pre-installation, post-installation, and improvement installation dates. Appendix A and B show the University of Arkansas (Razorbacks) football schedule for 2014 and 2015, respectively.

Table 1. Project Phase Schedule

Phase	Description	Start Date	End Date	Total Days
Pre-Installation	Home Game Weekend	1) 10/10/2014 2) 10/24/2014 3) 11/14/2014 4) 11/21/2014	10/12/2014 10/26/2014 11/16/2014 11/23/2014	12
	Away Game Weekend	5) 10/17/2014 6) 10/31/2014 7) 11/28/2014	10/19/2014 11/2/2014 11/30/2014	9
	No Game Weekend	8) 12/5/2014 9) 12/12/2014 10) 12/21/2014	12/7/2014 12/14/2014 12/23/2014	9
Installation		6/2/2015	6/2/2015	1
Post-Installation	Home Game Weekend	1) 9/4/2015 2) 10/23/2015 3) 11/20/2015 4) 11/27/2015	9/6/2015 10/25/2015 11/22/2015 11/29/2015	12
	Away Game Weekend	5) 9/11/2015 6) 11/6/2015 7) 11/13/2015	9/13/2015 11/8/2015 11/15/2015	9
	No Game Weekend	8) 12/4/2015 9) 12/11/2015 10) 12/18/2015	12/6/2015 12/13/2015 12/20/2015	9

Trespassers were coded based on three possible zones in which a trespasser could enter and exit the railroad ROW. The ROW study area and the location of these three zones are shown in Figure 11. A pedestrian was considered a trespasser if they stepped with both feet anywhere on ROW in the study area. However, for this study, pedestrians stepping onto the trespass guard panels without completely crossing the zone covered by the panels were not included in the analysis. To account for this during pre-installation, pedestrians who stepped on the ROW that was covered by the trespass guard panel post-installation were also not included in the study. The three zones where trespassers could enter and exit the railroad ROW were as follows:

- Zone 1: A pedestrian who trespassed in Zone 1 was accessing the ROW from the West Dickson Street crossing. The trespass guard panels were installed at this location.
- Zone 2: A pedestrian who trespassed in Zone 2 was accessing the ROW by climbing over Majestic Lounge patio railing.
- Zone 3: A pedestrian who trespassed in Zone 3 was entering the ROW from a pedestrian-only crossing located approximately 370 feet south of the West Dickson Street crossing.

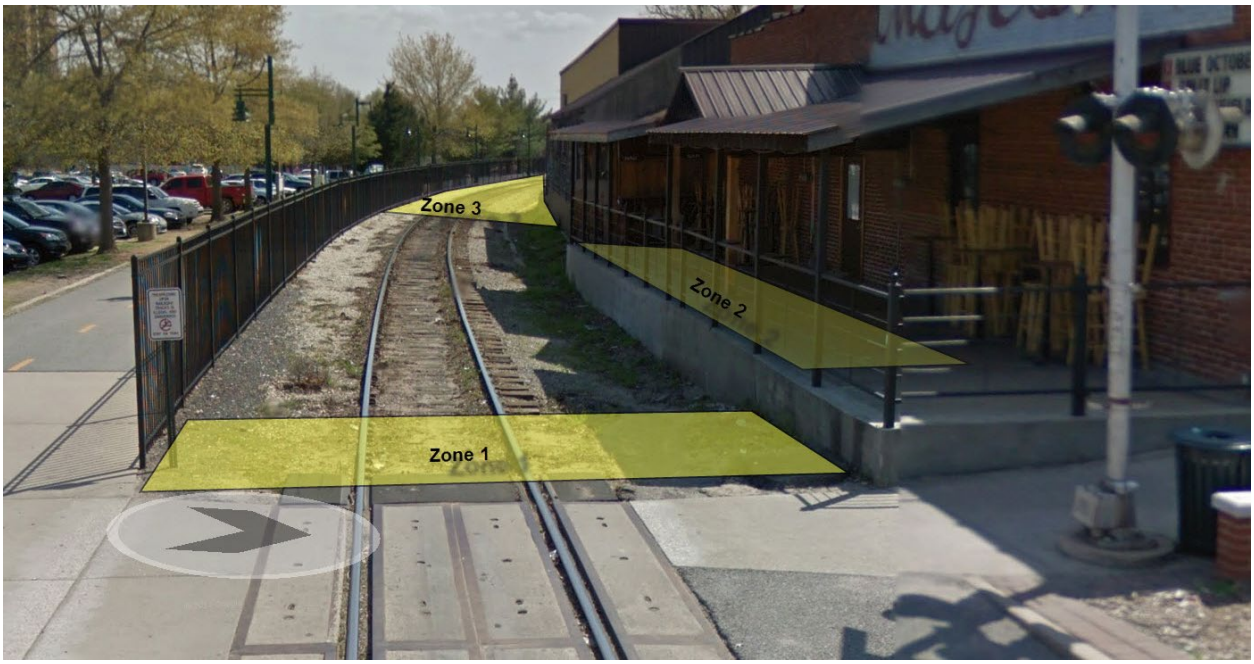

Figure 11. Zone Assignments for West Dickson Street Grade Crossing

5. Results

A total of 269 trespassers were observed from the 60 days of video data analyzed. Of those, 166 were coded prior to the installation of the anti-trespass guard panels and 103 were coded after the installation.

5.1 Pedestrian Behavior

The effectiveness of the anti-trespass guard panels was measured by comparing the frequency of pedestrians who trespassed onto the ROW before and after the panels were installed. Pedestrian movements as they trespassed onto the ROW were recorded with the research team implementing the same zone assignments from Figure 11 (where Zone 1 was area adjacent to the crossing, Zone 2 was Majestic Lounge patio, and Zone 3 was the area near pedestrian only crossing south of the West Dickson Street crossing). Table 2 shows the distribution of trespasser movements as they entered and exited the ROW during both the pre- and post-installation periods.

Table 2. Trespasser Paths

		Pre-Installation					**Post-Installation**			
		Exit Zone					Exit Zone			
		1	2	3	Total		1	2	3	Total
Entrance Zone	1	78 (47.0%)	17 (10.2%)	34 (20.5%)	129 (77.7%)		53 (51.5%)	4 (3.9%)	27 (26.2%)	84 (81.6%)
	2	4 (2.4%)	4 (2.4%)	0 (0%)	8 (4.8%)		2 (1.9%)	5 (4.9%)	0 (0%)	7 (6.8%)
	3	28 (16.9%)	0 (0%)	1 (0.6%)	29 (17.5%)		6 (5.8%)	0 (0%)	6 (5.8%)	12 (11.7%)
	Total	110 (66.3%)	21 (12.7%)	35 (21.1%)	166 (100%)		61 (59.2%)	9 (8.7%)	33 (32%)	103 (100%)

The overall number of trespass observations dropped by 38 percent, from 166 during pre-installation to 103 during post-installation. This change in trespass activity was evident by the 500 percent increase in pedestrian trespassing from Zone 3 to Zone 3 (1 pre vs. 6 post), a 76.5 percent decrease in pedestrian trespassing from Zone 1 to Zone 2 (17 pre vs. 4 post), and a 78.6 percent decrease in pedestrian trespassing from Zone 3 to Zone 1 (28 pre vs. 6 post). Note that the trespass guards at this location were designed to deter pedestrian traffic across Zone 1 only.

The researchers found no evidence the measure of pedestrian traffic was the same during both pre- and post-installation periods. However, the team made every effort to collect pedestrian activities for both periods under the same conditions. Both baseline and post data were collected for 10 weekends (Friday-Sunday), each from September to December one year apart, and included the same number of University of Arkansas home and away football games. The only significant change was that the warning devices at the crossing were upgraded from flashing lights before the installation of the anti-trespass guard panels to gates after their installation. The

research team believed this had minimal impact on pedestrian traffic or trespass activity, as none of the trespass activities recorded during both periods occurred during crossing activations.

5.1.1 Entering the ROW

Figure 12 illustrates the distribution of pedestrians who trespassed onto the ROW by location where they entered the ROW. As can be seen, the majority of the pedestrian trespass occurred from Zone 1, with 129 of 166 pre-installation observations and 84 of 103 after installation, followed by Zone 3, with 29 of 166 pre-installation and 12 of 103 after installation. The fewest pedestrian trespass observations originated from Zone 2, with 8 of 166 pre-installation and 7 of 103 after installation.

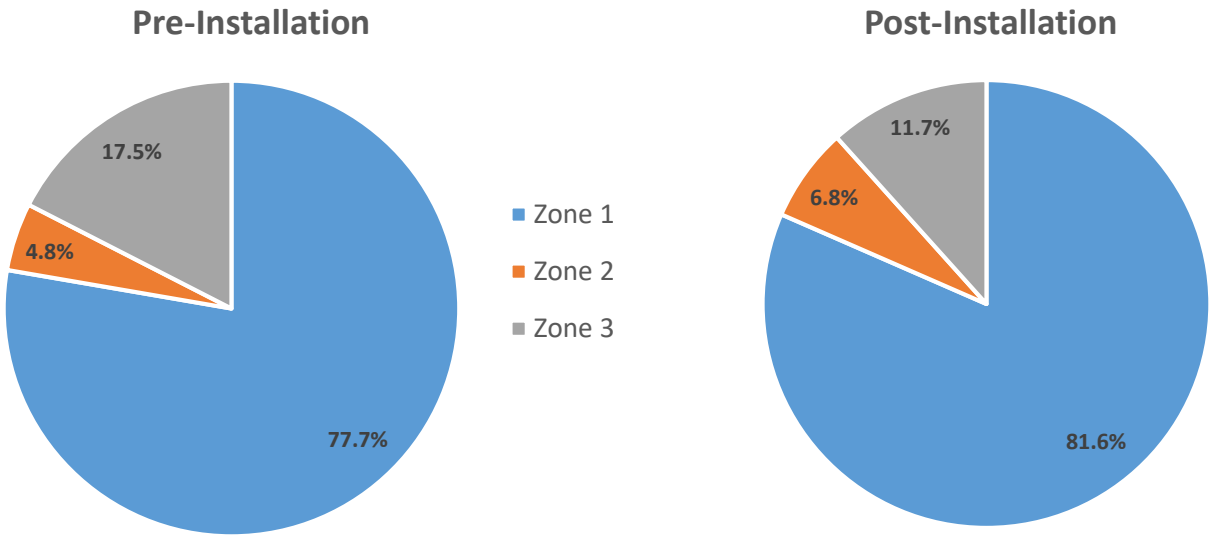

Figure 12. Where the Pedestrian Trespassed onto Railroad ROW

No significant changes in where trespassers entered the ROW were found from before to after the installation of the anti-trespass guard panels locations ($\chi 2 = 1.98$, df = 2, $P > 0.05$).

Examples of pedestrians trespassing from Zone 1, Zone 2, and Zone 3 are shown in Figure 13 through Figure 15, respectively. In Figure 13, two female trespassing pedestrians entered the railroad ROW from the crossing (Zone 1) by walking on the rails, then remained for approximately 90 seconds taking pictures before exiting via the crossing (Zone 1) by walking on the rails.

Figure 13. Example of Pedestrians Trespassing upon Railroad ROW from the Crossing (Zone 1)

In Figure 14, a male trespassing pedestrian entered the railroad ROW from the Majestic Lounge patio by climbing over the railing (Zone 2). The pedestrian picked up something he dropped and exited the ROW by climbing over the railing (Zone 2).

Figure 14. Example of a Pedestrian Trespassing from the Majestic Lounge Patio (Zone 2)

In Figure 15, a male trespassing pedestrian walking a dog entered the railroad ROW from the area south of the crossing (Zone 3) and exited via the crossing (Zone 1).

Figure 15. Example of a Pedestrian Trespassing from the Area South of the Crossing (Zone 3)

5.1.2 Exiting the ROW

Pedestrians who trespassed onto the ROW had three possible choices for where they could exit the ROW. Findings showed the majority of the pedestrians who trespassed exited the ROW from Zone 1, with 110 of 166 pre-installation and 61 of 103 after installation, followed by Zone 3, with 35 of 166 pre-installation and 33 of 103 after installation, and the fewest pedestrians exited from Zone 2, with 21 of 166 pre-installation and 9 of 103 after installation. Figure 16 illustrates the distribution of trespass events by exit location.

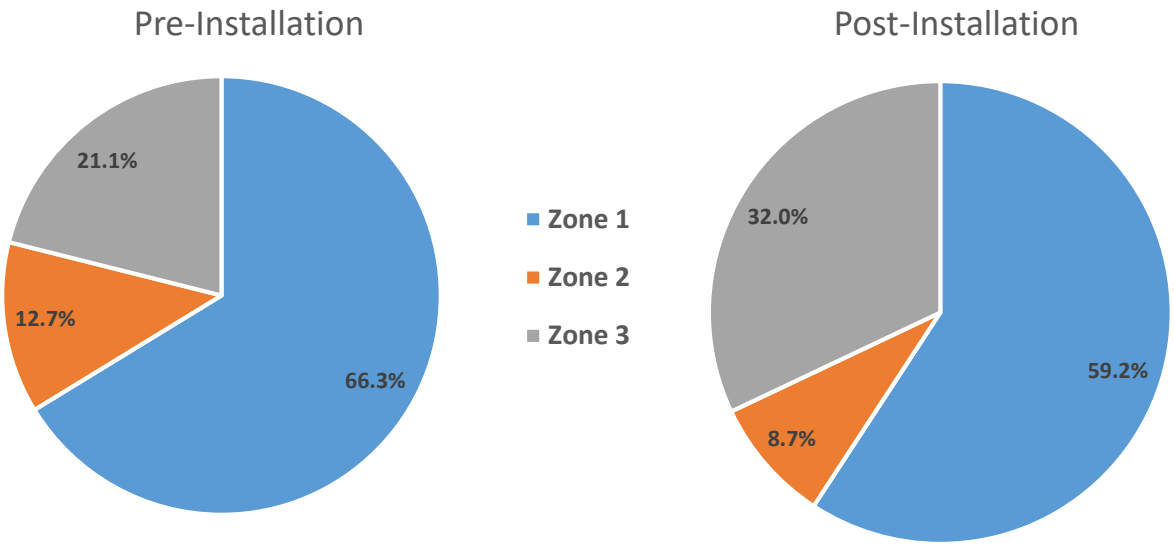

Figure 16. Where the Pedestrian Exited the Railroad ROW

Similar to the trespassing entrance path, there was no significant change in where trespassers exited the ROW after the installation of the anti-trespass guard panels ($\chi 2 = 4.39$, df = 2, P > 0.05). This indicates that although pedestrians may have changed their decision-making process prior to trespassing on railroad ROW, there was little change in where they exited the ROW once they decided to trespass.

5.2 Gender

Table 3 shows the distribution of trespassers by gender. As can be seen, males comprised 74.7 percent of the trespassers before the installation of the anti-trespass guard panels compared to 71.8 percent after the installation. There was slight decrease in proportion of male trespassers and slight increase in proportion female trespassers after the installation. However a chi-square test revealed a no significant change in the trespasser gender before and after installation ($\chi^2 = 0.27$, df = 1, p > 0.05).

Table 3. Trespassers by Gender: Before vs. After Installation

	Pre-Installation	Post-Installation
Male	124 (74.7%)	74 (71.8%)
Female	42 (25.3%)	29 (28.2%)
Total	166 (100%)	103 (100%)

5.3 Temporal Data

5.3.1 Time of Day

Pedestrians trespassed at all hours of the day. The majority of trespassing occurred at late night-early morning between 10:00 p.m. and 2:00 a.m. for both the pre- (46.4 percent) and post-installation (54.4 percent) periods. Figure 17 shows the distribution of trespass activity by the time of day for both pre- and post-installation periods.

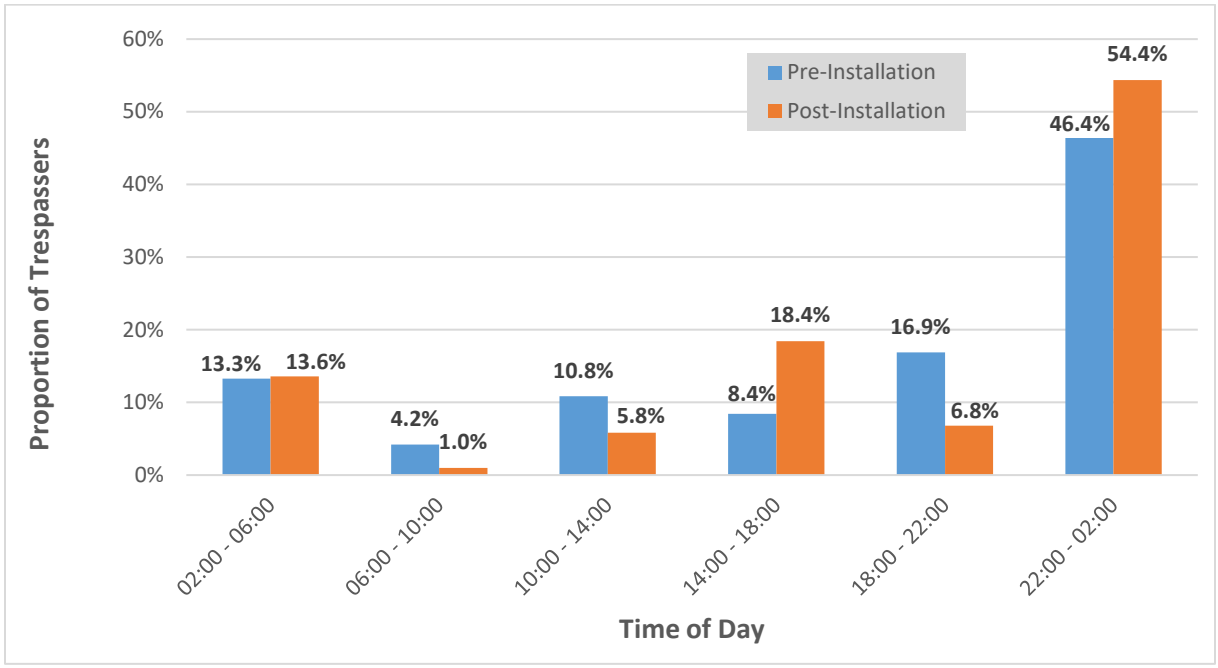

Figure 17. Proportion of Trespass Activity by Time of Day (Pre-Install n = 166 and Post-Install n = 103)

There was significant change in the time of day when pedestrians committed trespassing after the installation of the anti-trespass guard panels ($\chi^2 = 15.02$, df = 5, $P < 0.05$). This change was primarily due to an increase in the proportion of trespass occurrences from 2:00 p.m. to 6:00 p.m. and 10:00 p.m. to 2:00 a.m. and a decrease in the proportion of trespass occurrences from 6:00 a.m. to 10:00 a.m., 10:00 a.m. to 2:00 p.m., and 6:00 p.m. to 10:00 p.m.. The increase in proportion of trespassing during late night hours between 10:00 p.m. to 2:00 a.m. could be related to fact that the majority of the trespassers during this time were patrons of the Majestic Lounge, next to the ROW.

5.3.2 Day of Week

As discussed earlier in the report, video data was collected 24 hours a day, 7 days a week, but only weekend (Friday to Sunday) data was analyzed. The majority of trespassing occurred on Saturdays for both the pre- (40.4 percent) and post-installation (48.5 percent) periods. Table 4 shows the distribution of trespassing for both the pre- and post-installation periods by day of week.

Table 4. Trespassing by Day of Week: Before vs. After Installation

	Pre-Installation	Post-Installation
Friday	44 (26.5%)	33 (32.0%)
Saturday	67 (40.4%)	50 (48.5%)
Sunday	55 (33.1%)	20 (19.4%)
Total	166 (100%)	103 (100%)

After the installation of the anti-trespass guard panels, the proportion of trespassers increased by 20.9 percent and 20.3 percent on Friday and Saturday, respectively, and decreased by 41.4 percent on Sunday.

6. Summary of Findings

To evaluate the effectiveness of the anti-trespass guard panels at the West Dickson Street crossing, the research team sought answers to the following questions:

- Did the installation of the anti-trespass guard panels reduce the overall number of pedestrians who trespass onto railroad ROW?

  Yes. Prior to the installation of the panels, the team observed 166 pedestrians who trespassed onto the railroad ROW. After the installation, the team observed a 38 percent reduction (103 trespassers) in the number of pedestrians who trespassed onto the ROW.

  Note that both the baseline and post-installation data were collected for 10 weekend periods (Friday-Sunday), from September to December a year apart, and included the same number of home and away football game weekends.

- Did trespasser movement through the ROW change with the installation of anti-trespass guard panels? Specifically, did the entrance and exit paths differ before and after installation?

  Neither the entrance nor exit path of the trespassing pedestrians showed a significant change following the installation of the anti-trespass guard panel (Entrance: $\chi 2 = 1.98$, df = 2, $P > 0.05$ and Exit: $\chi 2 = 4.39$, df = 2, $P > 0.05$). Before the installation of the anti-trespass guard panels, most pedestrians trespassed by entering the ROW from the West Dickson Street crossing (77.7 percent), followed by from the area south of the crossing (17.5 percent), and from the Majestic Lounge patio (4.8 percent). After the installation, the order remained the same, but there was slight change in the proportion of the trespasser ROW entry point (81.6 percent, 11.7 percent, and 6.8 percent).

  Similar to trespassing entrance path, most trespassing pedestrians exited the ROW from the West Dickson Street crossing (66.3 percent pre vs. 59.2 percent post), followed by from the area south of the crossing (21.1 percent pre vs. 32 percent post), and from the Majestic Lounge patio (12.7 percent pre vs. 8.7 percent post).

Additional Findings:

The installation of the panels did not change trespassing behavior by gender. Before the installation, male pedestrians accounted for 74.7 percent and female pedestrians accounted for 25.3 percent of the trespassers. Whereas after the installation, male pedestrians accounted for 71.8 percent and female pedestrians accounted for 28.2 percent of the trespassers.

The times pedestrians trespassed were significantly different before and after the installation, with post-installation trespassing showing a significant increase from 2:00 p.m. to 6:00 p.m. and 10:00 p.m., to 2:00 a.m. and a significant decrease from 6:00 a.m. to 10:00 a.m., 10:00 a.m. to 2:00 p.m., and 6:00 p.m. to 10:00 p.m.

7. Conclusion

To formulate conclusions from the results, it is first necessary to state the study's limitations:

- Although both pre- and post-installation data was collected from September to December and included the same number of home and away football game weekends, there was no definitive evidence that pedestrian traffic was the same during the pre- and post-installation data collection periods.
- The site chosen for this study was adjacent to a very popular lounge and bar, which attracted many pedestrians late at night and who could have been under the influence of alcohol when exiting the establishment.
- The site tested in this study is parallel to a multi-use trail; therefore, there was no clear advantage to use the railroad ROW as shortcut.
- The grade crossing chosen for this study was equipped with flashing lights before the installation of the anti-trespass guard panels but was upgraded and equipped with two vehicular gates and four pedestrian gates after the installation.

Anti-trespass guard panels were effective in reducing number of pedestrians who trespassed onto the ROW. The number of trespassing pedestrians was reduced by 38 percent, from 166 before the installation of the anti-trespass guard panels to 103 after the installation.

Despite the positive effects on trespass activity, the anti-trespass guard panels had no effect on where trespassing pedestrians entered or exited the ROW. The majority of the trespassers entered and exited the ROW from the crossing, followed by from the area south of the crossing, and from the Majestic Lounge patio before and after the installation.

8. References

1. FRA Office of Safety Analysis website. Available at http://safetydata.fra.dot.gov/OfficeofSafety/Default.aspx accessed on November, 2017.
2. Office of Rail Regulation (U.K.). (2011). Level Crossings: A Guide for Managers, Designers, and Operations. Railway Safety Publication 7.

Appendix A.
2014 Arkansas Razorbacks Football Schedule

2014 Arkansas Razorbacks Football Schedule					
Date	**Day**	**Opponent**	**Location**	**Time**	**Score**
8/30/2014	Saturday	Auburn Tigers	Away	3:00 PM	Lost 45-21
9/6/2014	Saturday	Nicholls State Colonels	Home	3:00 PM	Won 73-7
9/13/2014	Saturday	Texas Tech Red Raiders	Away	2:30 PM	Won 49-28
9/20/2014	Saturday	Northern Illinois Huskies	Home	6:00 PM	Won 52-14
9/27/2014	Saturday	Texas A&M Aggies	Away	2:30 PM	Lost 35-28
10/4/2014	Saturday				
10/11/2014	Saturday	Alabama Crimson Tide	Home	5:00 PM	Lost 14-13
10/18/2014	Saturday	Georgia Bulldogs	Away	3:00 PM	Lost 45-32
10/25/2014	Saturday	UAB Blazers	Home	11:00 AM	Won 45-17
11/1/2014	Saturday	Mississippi State Bulldogs	Away	6:15 PM	Lost 17-10
11/8/2014	Saturday				
11/15/2014	Saturday	LSU Tigers	Home	7:00 PM	Won 17-0
11/22/2014	Saturday	Ole Miss Rebels	Home	2:30 PM	Won 30-0
11/28/2014	Friday	Missouri Tigers	Away	1:30 PM	Lost 21-14
12/29/2014	Monday	Texas Longhorns	Away	8:00 PM	Won 31-7

Appendix B.
2015 Arkansas Razorbacks Football Schedule

2015 Arkansas Razorbacks Football Schedule					
Date	**Day**	**Opponent**	**Location**	**Time**	**Score**
9/5/2015	Saturday	UTEP Miners	Home	2:30 PM	Won 48-13
9/12/2015	Saturday	Toledo Rockets	Away	3:00 PM	Lost 16-12
9/19/2015	Saturday	Texas Tech Red Raiders	Home	6:00 PM	Lost 35-24
9/26/2015	Saturday	Texas A&M Aggies	Away	6:00 PM	Lost 28-21
10/3/2015	Saturday	Tennessee Volunteers	Away	6:00 PM	Won24-20
10/10/2015	Saturday	Alabama Crimson Tide	Away	6:00 PM	Lost 27-14
10/17/2015	Saturday				
10/24/2015	Saturday	Auburn Tigers	Home	11:00 AM	Won 54-46
10/31/2015	Saturday	UT Martin Skyhawks	Home	3:00 PM	Won 63-28
11/7/2015	Saturday	Ole Miss Rebels	Away	2:30 PM	Won 53-52
11/14/2015	Saturday	LSU Tigers	Away	6:15 PM	Won 31-14
11/21/2015	Saturday	Mississippi State Bulldogs	Home	6:00 PM	Lost 51-50
11/27/2015	Friday	Missouri Tigers	Home	1:30 PM	Won 28-3
1/2/2016	Saturday	Kansas State Wildcats	Away	2:20 PM	Won 45-23

Abbreviations and Acronyms

Abbreviation or Acronym	Name
A&M	Arkansas and Missouri Railroad
AADT	Average Annual Daily Traffic
FRA	Federal Railroad Administration
HRI	Highway-Rail Intersection
RD&T	Research, Development, and Technology
ROW	Right-Of-Way
U.S. DOT	U.S. Department of Transportation
Volpe Center	John A. Volpe National Transportation Systems