Evaluating the Effectiveness of the City of Des Moines LED and RRFB Pedestrian Crossing Treatments on Multi-Lane Roadways

ctre
Center for Transportation Research and Education

Final Report
December 2012

IOWA STATE UNIVERSITY
Institute for Transportation

Sponsored by
Iowa Department of Transportation
(InTrans Project 10-387)

About CTRE

The mission of the Center for Transportation Research and Education (CTRE) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, and reliability while improving the learning environment of students, faculty, and staff in transportation-related fields.

Disclaimer Notice

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the sponsors.

The sponsors assume no liability for the contents or use of the information contained in this document. This report does not constitute a standard, specification, or regulation.

The sponsors do not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Non-Discrimination Statement

Iowa State University does not discriminate on the basis of race, color, age, religion, national origin, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. veteran. Inquiries can be directed to the Director of Equal Opportunity and Compliance, 3280 Beardshear Hall, (515) 294-7612.

Iowa Department of Transportation Statements

Federal and state laws prohibit employment and/or public accommodation discrimination on the basis of age, color, creed, disability, gender identity, national origin, pregnancy, race, religion, sex, sexual orientation or veteran's status. If you believe you have been discriminated against, please contact the Iowa Civil Rights Commission at 800-457-4416 or the Iowa Department of Transportation affirmative action officer. If you need accommodations because of a disability to access the Iowa Department of Transportation's services, contact the agency's affirmative action officer at 800-262-0003.

The preparation of this report was financed in part through funds provided by the Iowa Department of Transportation through its "Second Revised Agreement for the Management of Research Conducted by Iowa State University for the Iowa Department of Transportation" and its amendments.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Iowa Department of Transportation.

Technical Report Documentation Page

1. Report No.	**2. Government Accession No.**	**3. Recipient's Catalog No.**
InTrans Project 10-387		
4. Title and Subtitle		**5. Report Date**
Evaluating the Effectiveness of the City of Des Moines LED and RRFB Pedestrian Crossing Treatments on Multi-Lane Roadways		December 2012
		6. Performing Organization Code
7. Author(s)		**8. Performing Organization Report No.**
Neal Hawkins and Basak Aldemir Bektas		InTrans Project 10-387
9. Performing Organization Name and Address		**10. Work Unit No. (TRAIS)**
Center for Transportation Research and Education Iowa State University 2711 South Loop Drive, Suite 4700 Ames, IA 50010-8664		**11. Contract or Grant No.**
12. Sponsoring Organization Name and Address		**13. Type of Report and Period Covered**
Iowa Department of Transportation 800 Lincoln Way Ames, IA 50010		Final Report
		14. Sponsoring Agency Code
15. Supplementary Notes		
Visit www.intrans.iastate.edu for color pdfs of this and other research reports.		

16. Abstract

This project provides the City of Des Moines, Iowa with field information relative to pedestrian and motorist compliance when light-emitting diode (LED) pedestrian crossing signs or rectangular rapid-flash beacons (RRFBs) are used at multi-lane roadway crossings.

This study is limited in scope to two intersections. The study documented field observations of both pedestrian and motorist reactions. Tabular and graphical comparisons are provided by device type, actuation, location, and time of day.

Based on these findings, the City and possibly other communities may be able to make more informed decisions when considering the design, orientation, and operational treatments for pedestrian crossing locations.

17. Key Words		**18. Distribution Statement**	
crossing signs—LED signs—pedestrian-activated treatments—pedestrian crossings—pedestrian safety—rapid-flash beacons		No restrictions.	
19. Security Classification (of this report)	**20. Security Classification (of this page)**	**21. No. of Pages**	**22. Price**
Unclassified.	Unclassified.	28	NA

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

EVALUATING THE EFFECTIVENESS OF THE CITY OF DES MOINES LED AND RRFB PEDESTRIAN CROSSING TREATMENTS ON MULTI-LANE ROADWAYS

Final Report
December 2012

Principal Investigator
Neal Hawkins, Director
Center for Transportation Research and Education, Iowa State University

Co-Principal Investigator
Omar Smadi, Director
Roadway Infrastructure Management and Operations Systems, Iowa State University

Research Scientist
Basak Aldemir Bektas

Authors
Neal Hawkins and Basak Aldemir Bektas

Sponsored by
the Iowa Department of Transportation
(InTrans Project 10-387)

Preparation of this report was financed in part
through funds provided by the Iowa Department of Transportation
through its Research Management Agreement with the
Institute for Transportation

A report from
Institute for Transportation
Iowa State University
2711 South Loop Drive, Suite 4700
Ames, IA 50010-8664
Phone: 515-294-8103
Fax: 515-294-0467
www.intrans.iastate.edu

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

The authors would like to thank the Iowa Department of Transportation for sponsoring this research using Traffic Safety Improvement Program (TSIP) funding and the City of Des Moines Office of Traffic and Transportation for supporting the research effort.

EXECUTIVE SUMMARY

The City of Des Moines, Iowa has a number of marked crosswalk locations that are on multi-lane arterial roadways. In an effort to increase the visibility of pedestrians, and to alert motorists to their likely presence, many of these crossing locations have been accompanied by pedestrian-actuated devices. The City has used two different types of pedestrian-activated treatments, which this research evaluated:

- Push-button-activated pedestrian crossing sign treatment with solar-powered light-emitting diode (LED) yellow lights around the border of the crossing sign

- Push-button-activated rectangular rapid-flash beacons (RRFBs), which use an irregular yellow LED flash pattern that is similar to emergency flashers on police vehicles

The data for this study were collected at two pedestrian crossing locations within Des Moines:

- Mercy Hospital Campus pedestrian crossing of University Avenue at 4th Street (LED sign evaluated)

- Capitol Complex pedestrian crossing on East Grand Avenue at East 13th Street (LED sign and RRFB evaluated)

The study is limited in scope to these two intersections. The study documented field observations of both pedestrian and motorist reactions. Tabular and graphical comparisons are provided by device type, actuation, location, and time of day.

A summary of the findings follows:

- Overall, 85 percent of the crossing events occurred within the crosswalk with no need for pedestrians to wait 80 percent of the time. When pedestrians needed to wait for traffic, it mostly occurred on the curb (15 percent of the time). Crosswalk usage varied from 76 to 100 percent.

- The devices were activated 54 percent of the time, overall; however, specific rates varied across locations and time of day from a high of 73 percent activation to a low of 26 percent.

- Overall, pedestrians yielded prior to crossing 20 percent of the time. This varied by location, device type, and time of day. Pedestrian yielding varied by location and time of day from a low of 4 percent at the Capitol Complex RRFB crossing to a high of 55 percent at the Mercy Hospital Campus LED crossing, both during the a.m. period with the devices activated.

- Overall, 93 percent of the crossing events were completed while walking. Pedestrians ran 7 percent of the time and only 1 crossing was aborted.

- Overall, motorist braking actions were observed 39 percent of the time as opposed to no braking 24 percent of the time. A lack of braking was found to range from a low of 8 percent at two locations to a high of 59 percent at the Capitol Complex LED p.m. observation. In more than a third of the cases (37 percent) overall, no vehicles were present during the pedestrian crossing.

- Overall, motorists stopped for pedestrians 34 percent of the time versus no change in speed 20 percent of the time and slowing 9 percent of the time. Motorists stopping for pedestrians across locations ranged from a high of 44 percent to a low of 22 percent.

- When activated, motorists stopped for pedestrians in the crosswalk more than when the devices were not activated (72 versus 24 percent of the time).

- Pedestrians ran across the street more when the devices were not activated.

- The only instance of an aborted crossing occurred when the pedestrian had not activated the device.

Based on this information, the City and possibly other communities may be able to make more informed decisions when considering the design, orientation, and operational treatments for pedestrian crossing locations.

BACKGROUND

The City of Des Moines, Iowa has a number of marked crosswalk locations that are on multi-lane arterial roadways. In an effort to increase the visibility of pedestrians, and to alert motorists to their likely presence, many of these crossing locations have been accompanied by supplemental pedestrian-actuated sign treatments.

One of these treatments consists of a push-button-activated pedestrian crossing sign treatment with solar-powered light-emitting diode (LED) yellow lights around the border of the crossing sign, as shown Figure 1 on the left. The LED signs are typically placed back to back on a single aluminum pole with one pole on each side of the roadway.

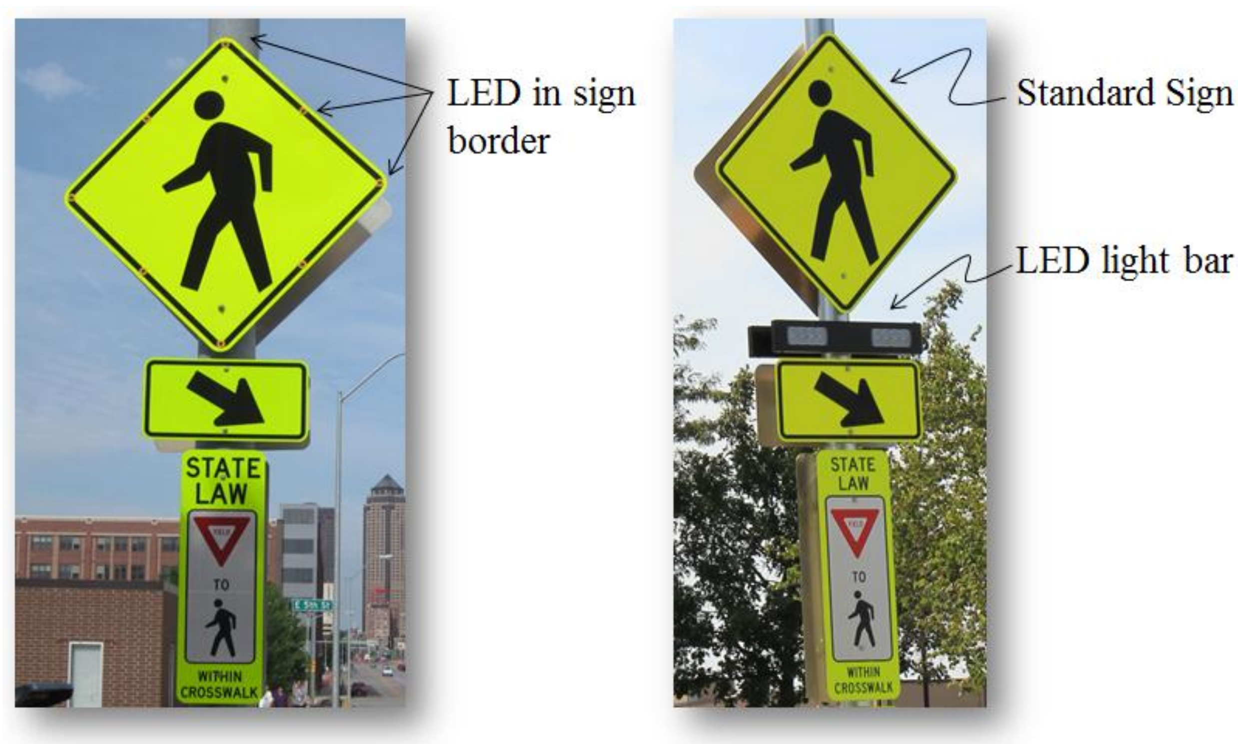

Figure 1. Pedestrian signs (LED left, RRFB right)

Prior to installing the LED signs at additional locations, the City initiated an evaluation of their effectiveness and wanted to contrast their potential effectiveness to rectangular rapid-flash beacons (RRFBs), which are shown on the right in Figure 1. The RRFB devices use an irregular yellow LED flash pattern that is similar to emergency flashers on police vehicles.

STUDY OBJECTIVES

This project provides the City with field information relative to pedestrian and motorist compliance when LED and RRFB signs are used on multi-lane roadways. The study is limited in scope to two intersections.

DATA COLLECTION

The data for this study were collected at two pedestrian crossing locations within Des Moines. Table 1. Intersection evaluation by device type

identifies the locations and time periods evaluated by device type.

Table 1. Intersection evaluation by device type

			LED			RRFB		
SERVING:	CROSSING:	NEAREST STREET:	AM	NOON	PM	AM	NOON	PM
Mercy Hospital	University Avenue	4th Street	☑	☑	☑			
Capitol Complex	East Grand Avenue	East 13th Street	☑	☑	☑	☑	☑	☑

The LED sign was evaluated at both intersections. The signs were originally installed at both locations in August of 2007 (prior to the study). In June of 2012, the City replaced the LED signs at the East Grand Avenue location with RRFBs and these signs were evaluated in August of 2012.

Location: Mercy Hospital Campus (University Avenue at 4th Street)

University Avenue is a four-lane divided arterial, which has a speed limit of 35 mph. Average daily traffic (ADT) was 17,600 vehicles per day (vpd) in 2008. The roadway is on a grade (downhill for eastbound motorists), lighted, has a wide raised grass median, and has two lanes of travel for each direction. Figure 2 provides an aerial and roadway view of this crossing location.

Figure 2. University Avenue crossing (aerial view top, eastbound view bottom)

Data were collected at this location on March 29, 2012 for the 7 to 9 a.m. morning period and 11 a.m. to 1 p.m. noon period and on April 2, 2012 for the 4 to 6 p.m. evening period.

Table 2 shows the frequency of crossing events by time of day and 15 minute time period. The number of pedestrians crossing during the morning, noon, and evening periods are relatively consistent at 74, 76, and 65 pedestrians, respectively.

Table 2. Pedestrian crossings by time of day (Mercy Hospital Campus LED)

Time Period	# Peds	Total
AM		
7:00 - 7:15	7	
7:15 - 7:30	11	
7:30 - 7:45	6	
7:45 - 8:00	16	
8:00 - 8:15	12	
8:15 - 8:30	4	
8:30 - 8:45	8	
8:45 - 9:00	10	74
Noon		
11:00 - 11:15	8	
11:15 - 11:30	11	
11:30 - 11:45	12	
11:45 - 12:00	16	
12:00 - 12:15	8	
12:15 - 12:30	10	
12:30 - 12:45	8	
12:45 - 1:00	3	76
PM		
4:00 - 4:15	9	
4:15 - 4:30	9	
4:30 - 4:45	10	
4:45 - 5:00	9	
5:00 - 5:15	13	
5:15 - 5:30	6	
5:30 - 5:45	4	
5:45 - 6:00	5	65

Location: Capitol Complex (East Grand Avenue at East 13th Street)

East Grand Avenue is a four-lane divided arterial, which has a 30 mph speed limit. ADT was 9,400 vpd in 2008. The roadway is level, lighted, undivided, and provides two lanes of travel for each direction. Figure 3 provides an aerial and roadway view of this crossing location.

Figure 3. East Grand Avenue crossing (aerial view top, eastbound view bottom)

Flashing LED Edge-Lit Sign

During the study period, two different types of pedestrian crossing signs were evaluated at this location. For the LED sign, the crossing events for the morning period were recorded on April 6, 2012. The noon and evening data collection was on April 12, 2012.

Table 3 shows the frequency of crossing events by time of day and 15 minute time period. The number of pedestrians crossing during the morning, noon, and evening periods are consistent at 78, 78, and 75 pedestrians, respectively. Significant peak periods occurred between 7:45 and 8:00 a.m. and between 4:30 and 4:45 p.m.

Table 3. Pedestrian crossings by time of day (Capitol Complex LED)

Time Period	# Peds	Total
AM		
7:00 - 7:15	5	
7:15 - 7:30	3	
7:30 - 7:45	11	
7:45 - 8:00	31	
8:00 - 8:15	20	
8:15 - 8:30	6	
8:30 - 8:45	1	
8:45 - 9:00	1	78
Noon		
11:00 - 11:15	6	
11:15 - 11:30	9	
11:30 - 11:45	11	
11:45 - 12:00	10	
12:00 - 12:15	7	
12:15 - 12:30	13	
12:30 - 12:45	11	
12:45 - 1:00	11	78
PM		
4:00 - 4:15	5	
4:15 - 4:30	10	
4:30 - 4:45	30	
4:45 - 5:00	12	
5:00 - 5:15	9	
5:15 - 5:30	5	
5:30 - 5:45	4	
5:45 - 6:00	0	75

Rectangular Rapid-Flash Beacon (RRFB)

The data collections for the RRFB were completed on July 31, 2012 for the noon and evening periods and on August 9, 2012 for the morning period. Table 4 shows the frequency of crossing events by time of day and 15 minute time period. The number of pedestrians crossing during the morning, noon, and evening periods were inconsistent at 125, 57, and 81 pedestrians, respectively. Significant peak periods occurred between 8:00 and 8:15 a.m. and between 4:30 and 4:45 p.m.

Table 4. Pedestrian crossing by time of day (Capitol Complex RRFB)

Time Period	# Peds	Total
AM		
7:00 - 7:15	2	
7:15 - 7:30	2	
7:30 - 7:45	8	
7:45 - 8:00	22	
8:00 - 8:15	38	
8:15 - 8:30	14	
8:30 - 8:45	10	
8:45 - 9:00	29	125
Noon		
11:00 - 11:15	6	
11:15 - 11:30	5	
11:30 - 11:45	7	
11:45 - 12:00	6	
12:00 - 12:15	6	
12:15 - 12:30	10	
12:30 - 12:45	10	
12:45 - 1:00	7	57
PM		
4:00 - 4:15	8	
4:15 - 4:30	3	
4:30 - 4:45	38	
4:45 - 5:00	14	
5:00 - 5:15	13	
5:15 - 5:30	2	
5:30 - 5:45	1	
5:45 - 6:00	2	81

DATA ANALYSIS

The data collection and analysis were executed based on pre-selected variables, which were identified in the project planning discussions. The list of variables and their meanings are presented below.

Variables

The variables were recorded for each crossing event. The analysis and graphs in the following sections are based on these observations.

 # Peds: Number of pedestrians who crossed the street. Multiple persons were counted if several people crossed the street simultaneously (numeric).

Push Btn: Whether the pedestrian(s) pushed the button to activate the flashing LED sign edge or the RRFB (yes or no; nominal).

Inxwalk: Whether the pedestrian(s) crossed the roadway within the crosswalk (yes or no, nominal).

Pedyield: Whether the pedestrian(s) yielded (yes or no; nominal).

Waiting: Where the pedestrian(s) waited (no: no waiting, street: waited in the street, curb: waited at the curb, median: waited at the median, no vehicles: there were no vehicles as the pedestrian(s) crossed; nominal).

Xing: Whether the pedestrian(s) walked, ran, or aborted the crossing (nominal).

Bad Xing: Indicates only those crossings when the pedestrian hesitated, ran, or aborted the crossing (nominal).

Pdelay: Pedestrian delay in seconds (numeric).

Myield: Whether the pedestrian(s) yielded (yes, no, or no vehicles; nominal).

Mspeedch: Whether the motorist changed their speed for the pedestrian (no, stop, slow, or no vehicles; nominal).

Analysis

The analysis focused on the basic operations for each pedestrian crossing by evaluation period and pedestrian/motorist interactions. This section provides a summary and analysis of findings.

Crossing Orientation and Pedestrian Wait Locations

To be effective, a crosswalk needs to be within the relative path of pedestrian travel. At the University Avenue crossing, pedestrians are traveling between surface parking lots on the north side of University Avenue and the Mercy Hospital Campus on the south. At the Capitol Complex location, pedestrians are traveling between buildings and, again, to access surface parking lots, crossing East Grand Avenue.

The analysis included pedestrian behavior when crossing the roadways as far as if and where they waited to cross and/or if they waited at all. Table 5. Crosswalk usage and wait location

provides a summary of observations.

Table 5. Crosswalk usage and wait location

			In Crosswalk		Waiting				
Location	Time Period	Xing Events	no	yes	curb	street	median	<40 feet	none
All	All	576	15%	85%	15%	2%	2%	1%	80%
Mercy LED	AM	67	12%	88%	49%	7%	0%	0%	43%
Mercy LED	NOON	58	24%	76%	19%	7%	0%	0%	74%
Mercy LED	PM	57	37%	63%	16%	0%	14%	9%	61%
Capitol LED	AM	60	0%	100%	0%	0%	0%	0%	100%
Capitol LED	NOON	67	18%	82%	22%	1%	0%	0%	76%
Capitol LED	PM	61	7%	93%	16%	0%	2%	0%	82%
Capitol RRFB	AM	94	19%	81%	4%	1%	0%	0%	95%
Capitol RRFB	NOON	51	10%	90%	8%	0%	0%	0%	92%
Capitol RRFB	PM	61	5%	95%	3%	2%	0%	0%	95%

Overall, 85 percent of the crossing events occur within the crosswalk and pedestrians do not need to wait to cross 80 percent of the time. When pedestrians need to wait for traffic, it mostly occurs on the curb (15 percent of the time).

Crosswalk usage varied from 76 to 100 percent usage. The Mercy/University Avenue LED crossing location was unusual in that 49 percent of the events had pedestrians waiting at the curb prior to crossing the roadway in the morning.

Actuation

The LED signs and RRFBs that were installed and evaluated require pedestrian activation. This analysis began with the basic question of whether or not pedestrians who are crossing near or at the crosswalk are taking the time to push the actuator button. Table 6 provides a summary for all sites by location and device type and time period.

Table 6. Pedestrian device actuation

Location	Time Period	Xing Events	Used Push Button: no	Used Push Button: yes
All	All	576	46%	54%
Mercy LED	AM	67	49%	51%
Mercy LED	NOON	58	64%	36%
Mercy LED	PM	57	74%	26%
Capitol LED	AM	60	27%	73%
Capitol LED	NOON	67	49%	51%
Capitol LED	PM	61	39%	61%
Capitol RRFB	AM	94	40%	60%
Capitol RRFB	NOON	51	43%	57%
Capitol RRFB	PM	61	34%	66%

As shown, the devices are actuated 54 percent of the time, overall, however, specific rates varied across locations and time of day from a high of 73 percent activation to a low of 26 percent.

Pedestrians Yielding

Observations were recorded in terms of whether or not pedestrians yielded prior to entering the crosswalk. The researchers caution readers on interpreting these results, given the variety of undefined causative factors. Table 7 shows that, overall, pedestrians yielded prior to crossing 20 percent of the time.

Pedestrian yielding varied by location and time of day from a low of 4 percent at the Capitol Complex RRFB crossing to a high of 55 percent at the Mercy Hospital Campus LED crossing, both during the a.m. period with the devices activated.

Table 7. Pedestrians yielding

Location	Time Period	Xing Events	Pedestrian Yield		
			no	yes	no vehicles
All	All	576	46%	20%	33%
Mercy LED	AM	67	45%	55%	0%
Mercy LED	NOON	58	47%	22%	31%
Mercy LED	PM	57	33%	39%	28%
Capitol LED	AM	60	43%	10%	47%
Capitol LED	NOON	67	33%	24%	43%
Capitol LED	PM	61	39%	20%	41%
Capitol RRFB	AM	94	63%	4%	33%
Capitol RRFB	NOON	51	51%	8%	41%
Capitol RRFB	PM	61	56%	7%	38%

Pedestrian Crossing Actions

Once the pedestrian was within the crosswalk observers noted their actions in terms of whether or not they walked, ran, or aborted the crossing. Table 8 shows these findings by time, location, and device type.

Table 8. Pedestrian crossing actions

Location	Time Period	Xing Events	Pedestrian Crossing		
			walk	run	abort
All	All	576	535	40	1
Mercy LED	AM	67	91%	9%	0%
Mercy LED	NOON	58	81%	17%	2%
Mercy LED	PM	57	84%	16%	0%
Capitol LED	AM	60	98%	2%	0%
Capitol LED	NOON	67	94%	6%	0%
Capitol LED	PM	61	97%	3%	0%
Capitol RRFB	AM	94	96%	4%	0%
Capitol RRFB	NOON	51	94%	6%	0%
Capitol RRFB	PM	61	98%	2%	0%

Overall, 93 percent of the crossing events were completed while walking. Pedestrians ran across 7 percent of the time and only 1 crossing was aborted (Mercy Hospital Campus at noon).

Motorists Yielding

The ultimate purpose of the LED signs and RRFBs is to gain motorist compliance in yielding to pedestrians at roadway crossings. Table 9 documents the findings in terms of motorists yielding and braking for pedestrians at each crossing for each device type.

Table 9. Motorists yielding

			Motorists Yield		
Location	Time Period	Xing Events	no	yes	no vehicles
All	All	576	24%	39%	37%
Mercy LED	AM	67	27%	46%	27%
Mercy LED	NOON	58	28%	40%	33%
Mercy LED	PM	57	40%	30%	30%
Capitol LED	AM	60	8%	45%	47%
Capitol LED	NOON	67	24%	33%	43%
Capitol LED	PM	61	59%	0%	41%
Capitol RRFB	AM	94	14%	51%	35%
Capitol RRFB	NOON	51	18%	41%	41%
Capitol RRFB	PM	61	8%	54%	38%

Overall, motorist braking actions were observed 39 percent of the time as opposed to no braking 24 percent of the time. A lack of braking was found to range from a low of 8 percent at two locations to a high of 59 percent with the Capitol Complex LED p.m. observation. In more than a third of the cases (37 percent) overall, no vehicles were present during the pedestrian crossing.

Changes in Vehicle Speeds

Field observations were used to compare motorist speed selection at each crossing, as shown in Table 10 by crossing location, device type, and time period.

Overall, motorists stopped for pedestrians 34 percent of the time versus no change in speed 20 percent of the time and slowing 9 percent of the time. Motorists stopping for pedestrians across locations ranged from a high of 44 percent to a low of 22 percent.

Table 10. Changes in vehicle speeds

			Motorists Speed Change			
Location	Time Period	Xing Events	no change	slow	stop	no vehicles
All	All	576	20%	9%	34%	37%
Mercy LED	AM	67	27%	9%	37%	27%
Mercy LED	NOON	58	31%	5%	31%	33%
Mercy LED	PM	57	39%	5%	28%	28%
Capitol LED	AM	60	12%	10%	32%	47%
Capitol LED	NOON	67	24%	10%	22%	43%
Capitol LED	PM	61	11%	8%	39%	41%
Capitol RRFB	AM	94	14%	12%	39%	35%
Capitol RRFB	NOON	51	18%	8%	33%	41%
Capitol RRFB	PM	61	8%	10%	44%	38%

Influence of Device Actuation

A comparison of motorist behavior specific to when the LED signs and RRFBs were activated was made. Here, pushing the button for the crosswalk was used as a variable given that activates each device; the number of motorists that did not stop (no change in speed), stopped, or slowed down were compared.

Figure 4 shows the findings for the Mercy Hospital Campus LED evaluation.

Row Labels	Count	
no	71	
no change	47	66%
slow	7	10%
stop	17	24%
yes	58	
no change	11	19%
slow	5	9%
stop	42	72%
Grand Total	129	

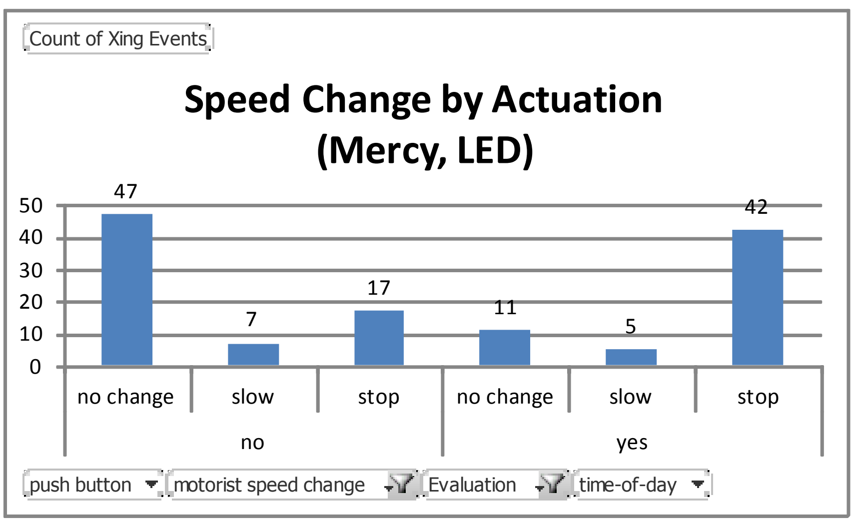

Figure 4. Speed change by actuation (Mercy Hospital Campus LED)

When activated, motorists stopped for pedestrians in the crosswalk 72 percent of the time as opposed to only 24 percent of the time when not activated. The number of motorists slowing was about the same when activated versus not (9 percent versus 10 percent, respectively). The number of motorists with no change to their speed was 19 percent when activated as opposed to a much higher 66 percent when not activated.

Figure 5 shows the findings for the Capitol Complex LED evaluation.

Row Labels	Count	
no	30	
no change	20	67%
stop	10	33%
yes	76	
no change	10	13%
slow	18	24%
stop	48	63%
Grand Total	106	

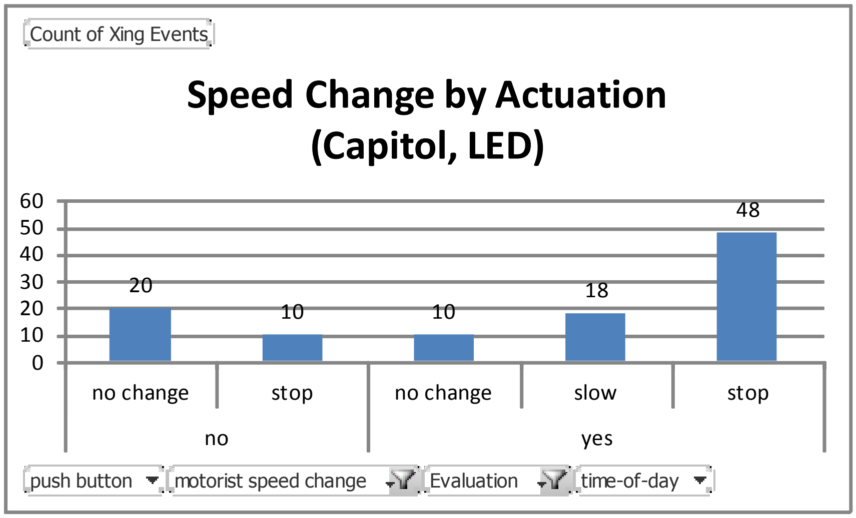

Figure 5. Speed change by actuation (Capitol Complex LED)

When activated, motorists stopped for pedestrians in the crosswalk 63 percent of the time as opposed to only 33 percent of the time when not activated. Twenty four percent of the motorists slowed when activated versus none when not activated. The number of motorists with no change to their speed was 13 percent when activated as opposed to a much higher 67 percent when not activated.

Figure 6 shows the findings for the Capitol Complex RRFB evaluation.

When activated, motorists stopped for pedestrians in the crosswalk 73 percent of the time as opposed to only 30 percent of the time when not activated. Eighteen percent of motorists slowed when activated versus 10 percent when not activated. The number of motorists with no change to their speed was 9 percent when activated as opposed to a much higher 60 percent when not activated.

Row Labels	Count of Xing Events	
no	30	
no change	18	60%
slow	3	10%
stop	9	30%
yes	99	
no change	9	9%
slow	18	18%
stop	72	73%
Grand Total	129	

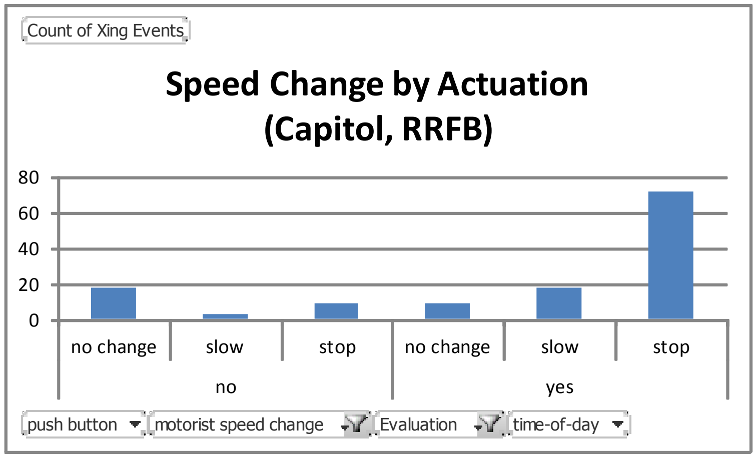

Figure 6. Speed change by actuation (Capitol Complex RRFB)

A comparison of pedestrian crossing actions (walk, run, or abort) by device activation was made, with the results presented in Table 11.

Table 11. Pedestrian crossing by actuation

Location	Total	Push-Button Activated		Push-Button Not-Activated	
Mercy LED					
Walk	156	67	43%	89	57%
Run	25	3	12%	22	88%
Abort	1	0	0%	1	100%
Capitol LED					
Walk	181	113	62%	68	38%
Run	7	2	29%	5	71%
Abort	0	0	-	0	-
Capitol RRFB					
Walk	198	122	62%	76	38%
Run	8	3	38%	5	63%
Abort	0	0	-	0	-

The following observations are relevant.

Walk – For the Mercy Hospital Campus LED crossing, more pedestrians crossed without activating the devices than with activation. A consistent 62 percent of the crossings were made using the push button at the Capitol Complex location during both the LED and RRFB evaluations.

Run – Pedestrians ran more times when the devices were not activated than with them activated.

Abort – The one instance of an aborted crossing was when the device was not activated.

Comparison of LED and RRFB

A comparison between the two device types was made for the Capitol Complex (same crossing location). Figure 7 presents the motorist changes in speed when pedestrians activated the devices versus when they did not.

Row Labels	Count	
no	**60**	
Capitol LED	**30**	
no change	20	67%
stop	10	33%
Capitol RRFB	**30**	
no change	18	60%
slow	3	10%
stop	9	30%
yes	**175**	
Capitol LED	**76**	
no change	10	13%
slow	18	24%
stop	48	63%
Capitol RRFB	**99**	
no change	9	9%
slow	18	18%
stop	72	73%
Grand Total	**235**	

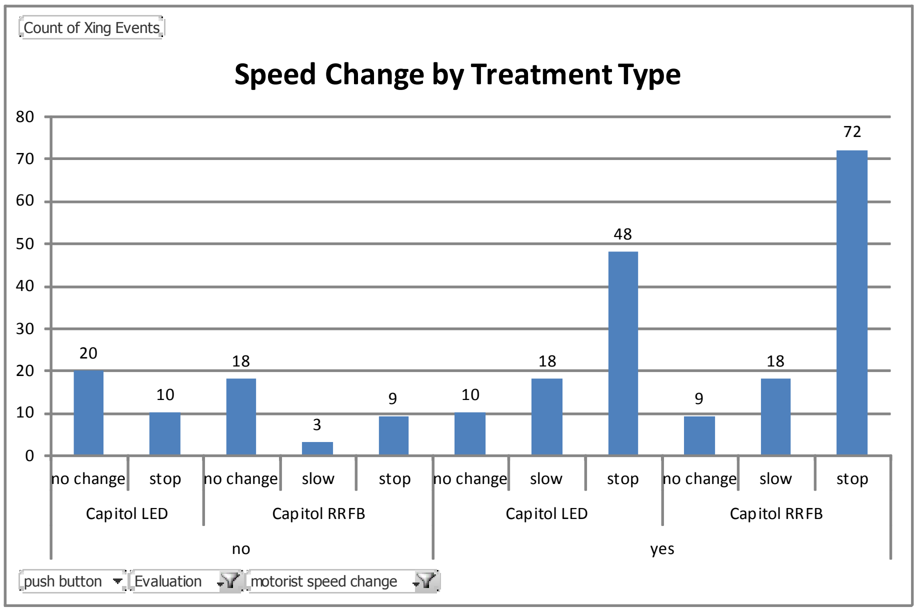

Figure 7. Speed change by treatment type

As shown, the percentage of motorists who stopped when the device was active is slightly higher at 73 percent for RRFB versus 63 percent for LED. The percentage of motorists who slowed down was slightly higher for the LED sign at 24 percent versus 18 percent for the RRFB. The percentage of motorists with no change in speed was slightly lower for the RRFB at 9 percent versus 13 percent for the LED sign.

CONCLUSIONS

This project provides the City with field information relative to pedestrian and motorist compliance when the LED sign treatments and RRFBs are used at multi-lane roadway crossings. The study documented field observations of both pedestrian and motorist reactions.

The study is limited in scope to two intersections. Tabular and graphical comparisons are provided by device type, actuation, location, and time of day.

A summary of the findings follows:

- Overall, 85 percent of the crossing events occurred within the crosswalk with no need for pedestrians to wait 80 percent of the time. When pedestrians needed to wait for traffic, it mostly occurred on the curb (15 percent of the time). Crosswalk usage varied from 76 to 100 percent.

- The devices were activated 54 percent of the time, overall; however, specific rates varied across locations and time of day from a high of 73 percent activation to a low of 26 percent.

- Overall, pedestrians yielded prior to crossing 20 percent of the time. This varied by location, device type, and time of day. Pedestrian yielding varied by location and time of day from a low of 4 percent at the Capitol Complex RRFB crossing to a high of 55 percent at the Mercy Hospital Campus LED crossing, both during the a.m. period with the devices activated.

- Overall, 93 percent of the crossing events were completed while walking. Pedestrians ran 7 percent of the time and only 1 crossing was aborted.

- Overall, motorist braking actions were observed 39 percent of the time as opposed to no braking 24 percent of the time. A lack of braking was found to range from a low of 8 percent at two locations to a high of 59 percent at the Capitol Complex LED p.m. observation. In more than a third of the cases (37 percent) overall, no vehicles were present during the pedestrian crossing.

- Overall, motorists stopped for pedestrians 34 percent of the time versus no change in speed 20 percent of the time and slowing 9 percent of the time. Motorists stopping for pedestrians across locations ranged from a high of 44 percent to a low of 22 percent.

- When activated, motorists stopped for pedestrians in the crosswalk more than when the devices were not activated (72 versus 24 percent of the time).

- Pedestrians ran across the street more when the devices were not activated.

- The only instance of an aborted crossing occurred when the pedestrian had not activated the device.

Based on this information, the City and possibly other communities may be able to make more informed decisions when considering the design, orientation, and operational treatments for pedestrian crossing locations.