Roundabouts—The Maryland Experience

A Maryland Success Story

This case study is one in a series documenting successful intersection safety treatments and the crash reductions that were experienced. Traffic engineers and other transportation professionals can use the information contained in the case study to answer the following questions:

- What is an intersection alternative to improve safety at rural two-way stop-controlled intersections?
- How many crashes did the treatment reduce?
- Are there implementation issues associated with roundabouts, and if so, how can they be overcome?

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U.S. Department of Transportation
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Safe Roads for a Safer Future
Investment in roadway safety saves lives

Introduction

Intersections represent one of the most dangerous places for drivers on the road today. According to the National Highway Traffic Safety Administration (NHTSA) 733,000 injury crashes and 7,196 fatal intersection-related crashes occurred in the United States in 2008[1]. Intersections are inherently dangerous because of the conflicts that occur when vehicles cross or turn in traffic. Modern roundabout intersections are a dramatically safer intersection choice because they eliminate numerous vehicular conflicts.

Objective

The following case study presents selected findings from a study conducted by the Maryland State Highway Administration (MDSHA) that evaluated the safety benefits of modern roundabout intersections compared to two-way stop-controlled intersections. Maryland has more than 60 roundabouts in operation.

"Roundabouts can offer a good solution to safety and capacity problems at intersections. Roundabouts can also offer high capacity at intersections without requiring the expense of constructing and maintaining a traffic signal."

Maryland State Highway Administration

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Treatment Summary

All intersection examples used in this report are from Maryland. This case study examines conversion of five two-way stop-controlled intersections to roundabout intersections.

Roundabouts are circular intersections with specific design and traffic control features. These features include yield control of all entering traffic, channelized approaches, and appropriate geometric curvature to ensure that travel speeds on the circulatory roadway are typically less than 30 miles per hour (mph). Also, traffic movement is possible only in a counter-clockwise direction within the roundabout. Federal Highway Administration's (FHWA) *Roundabouts: An Informational Guide* provides more information on the defining characteristics and definitions for each of the key features of a roundabout.

Roundabout intersections eliminate a number of vehicle conflict points typically associated with traditional intersections. A four-legged, single-lane roundabout has 75 percent fewer vehicle conflict points than a traditional stop-controlled intersection [2]. Roundabouts also enhance safety by reducing vehicle speeds both in and through the intersection.

Evaluation Methodology

This case study examines five intersections, with a high incidences of crashes (many with injuries), that were converted to roundabouts. Crash reduction results were based on a review of "before and after" data from these intersections during a minimum of 15 years, between 1990—2007[1]. (The "before" and "after" observation periods ranged from five years to more than thirteen years at the treated intersections).

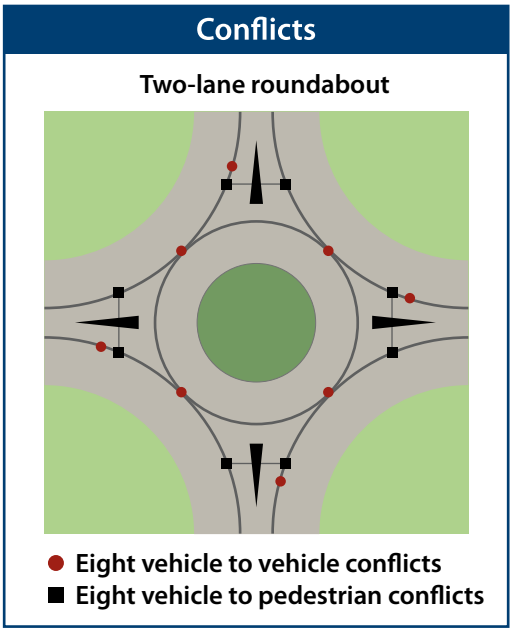

Figure 1: Eight Vehicle Conflict Points
Source: FHWA Roundabouts: An Informational Guide

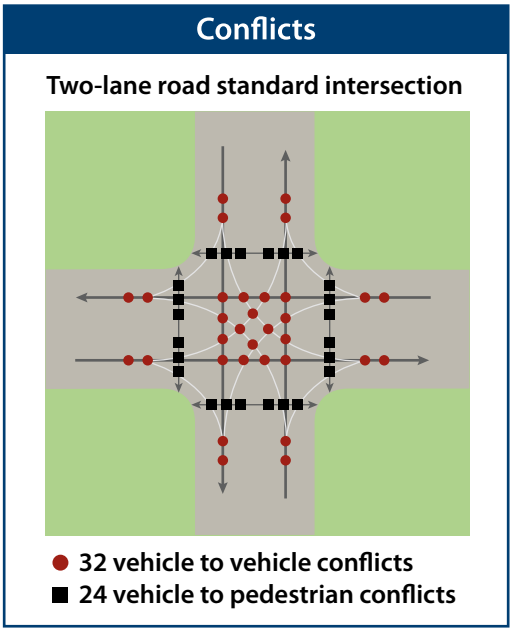

Figure 2: 32 Vehicle Conflict Points
Source: FHWA Roundabouts: An Informational Guide

[1] *Note that crash reduction averages in this report reflect the percent reduction per year based on the difference between the total number of "before" and "after" crashes.*

Results

Problem: Five rural, two-way, stop-controlled intersections in Maryland were experiencing a high incidence of injury crashes.

Solution: MDSHA wanted to reduce the number of crashes while maintaining capacity and reducing costs. They decided to convert five two-way stop-controlled intersections to single-lane roundabout intersections.

Table 1 summarizes the "before and after" crash analysis at the five roundabouts. Following the table is a brief discussion of the results at each roundabout.

Locations	Implem-entation Date	Before				After				Percent Reduction In Crashes/Year		
		Months	Total Crashes	Injury Crashes	Fatal Crashes	Months	Total Crashes	Injury Crashes	Fatal Crashes	Total Crashes	Injury Crashes	Fatal Crashes
Cearfoss (MD-58 and MD-63/ MD-494)	Dec-95	60	19	8	1	121	9	1	0	76.5%	93.8%	100.0%
Lisbon (MD-94 and MD-144)	Apr-93	60	42	19	0	161	18	4	0	84.0%	92.2%	0.0%
Lothian (MD-2 and MD-408/ MD-422)	Oct-95	60	39	26	1	122	40	11	0	49.6%	79.2%	100.0%
Taneytown (MD-140 and MD-832/ Antrim Boulevard)	Aug-96	60	30	15	0	112	10	3	0	82.1%	89.3%	0.0%
Leeds (MD-213 and Leeds Road/Elk Mills Road)	Aug-95	60	20	14	1	124	22	2	0	46.8%	93.1%	100.0%
TOTAL		**300**	**150**	**82**	**3**	**640**	**99**	**21**	**0**	**69.1%**	**88.0%**	**100.0%**

Table 1: Summary of crash reductions after conversion to roundabout intersections.

Cearfoss Roundabout, Washington County

This single-lane rural roundabout is located at the intersection of MD-58 and MD-63/MD-494. This was a two-way stop-controlled intersection prior to the construction of the roundabout. MD-63 from the north and south has the right-of-way. The posted speed limit on MD-63 is 50 mph in both directions and 30 mph along both approaches of MD-58 and MD-494.

The roundabout was constructed with a 116 ft inscribed circle diameter, including a circulatory roadway 16 ft wide. The landscaped central island has a radius of 42 ft with an apron width of 12 ft. The approach and departure lane widths of MD-63 from the south are 10 ft, with entry and exit widths of 13 ft and 15 ft, respectively. The approach and departure lane widths of MD-63 from the north are 10 ft and 11 ft, with entry and exit widths of 11 ft and 13 ft, respectively.

The roundabout cost approximately $386,145 to design and construct, and opened to traffic in December 1995 to serve a total peak hour approach volume of 800 vehicles. **The Cearfoss Roundabout resulted in a crash reduction of 76.5 percent and reduced injury crashes by 93.8 percent per year. Fatal crashes were eliminated.**

Photo provided by Maryland State Highway Administration (used with permission).

Figure 3: Cearfoss Roundabout, MD

Lisbon Roundabout, Howard County

This roundabout is located at the rural intersection of MD-94 and MD-144 in Lisbon, Maryland. Prior to construction of the roundabout, this was a two-way stop-controlled intersection. The posted speed limit is 45 mph on MD-94 and 35 mph on MD-144.

The roundabout was constructed with an inscribed circle diameter of 100 ft, including a circulatory roadway 18 ft wide. The landscaped central island has a radius of 32 ft with an apron width of 12 ft. The entry and exit widths on MD-94 and MD-144 are 18 ft.

The roundabout cost approximately $194,000 to design and construct, and opened to traffic in April 1993 to serve a peak hour total approach volume of 696 vehicles. **The Lisbon Roundabout resulted in a crash reduction of 84 percent and reduced injury crashes by 92.2 percent per year. No fatal crashes have occurred.**

Photo provided by Maryland State Highway Administration (used with permission).

Figure 4: Lisbon Roundabout, MD

Lothian Roundabout, Anne Arundel County

This single-lane roundabout is located at the intersection of MD-2 and MD-408/MD-422. Prior to construction of the roundabout, this was a two-way stop-controlled intersection. MD-2 from the east and MD-408 from the west have the right-of-way. The posted speed limit along MD-2 and MD-408/MD-422 for both approaches is 40 mph.

The roundabout was constructed with an inscribed circle diameter of 120 ft, including a circulatory roadway 18 ft wide. The landscaped central island has a radius of 42 ft, with an apron width of 12 ft. Approach and departure lane widths on all the approaches are 10 ft.

The roundabout cost approximately $493,880 to design and construct, and opened to traffic in October 1995 to serve a total peak hour approach volume of 1,400 vehicles. **The Lothian Roundabout resulted in a crash reduction of 49.6percent and reduced injury crashes by 79.2 percent per year. Fatal crashes were eliminated.**

Photo provided by Maryland State Highway Administration (used with permission).

Figure 5: Lothian Roundabout, MD

Taneytown Roundabout, Carroll County

This single-lane roundabout is located at the intersection of MD-140 and MD-832/Antrim Boulevard. Prior to construction of the roundabout, this was a two-way stop-controlled intersection. MD-140 from the north and MD-832 have the right-of-way. The posted speed limit on MD-140 from the north is 30 mph and MD-832 from the south is 40 mph. MD-140 from the east has a posted speed limit of 50 mph and Antrim Boulevard has a posted speed limit of 30 mph.

The roundabout was constructed with an inscribed circle diameter of 150 ft, including a circulatory roadway width of 30 ft. The landscaped central island has a radius of 42 ft, with an apron width of 10 ft. The intersection geometrics are such that MD-140 from the north and MD-832 from the south are provided with channelized free right-turn lanes and a single through/left-turn lane. MD-140 from the east and Antrim Boulevard from the west share a single through/left-turn lane in each direction.

The approach and departure lane widths along Antrim Boulevard from the west are 24 ft, with entry and exit widths of 16 ft and 13 ft, respectively. The approach and departure lane widths along MD-140 from the east are 24 ft with entry and exit widths of 24 ft, as well.

The roundabout cost approximately $464,540 to design and construct, and opened to traffic in August 1996 to serve a total peak hour approach volume of 1,300 vehicles. **The Taneytown Roundabout resulted in a crash reduction of 82.1 percent and reduced injury crashes by 89.3 percent per year. No fatal crashes have occurred.**

Photo provided by Maryland State Highway Administration (used with permission).

Figure 6: Taneytown Roundabout, MD

Leeds Roundabout, Cecil County

This single-lane roundabout is located at the intersection of MD-213 and Leeds Road/Elk Mills Road. Prior to the construction of the roundabout, this was a two-way stop-controlled intersection. MD-213 has the right-of-way. The posted speed limit along MD-213 for both approaches is 45 mph and 25 mph along Leeds Road/Elk Mills Road. The roundabout was constructed with an inscribed circle diameter of 110 ft.

The roundabout cost approximately $472,014 to design and construct, and opened to traffic in August 1995 to serve a total peak hour approach volume of 847 vehicles. **The Leeds Roundabout resulted in a crash reduction of 46.8 percent and reduced injury crashes by 93.1 percent per year. No fatal crashes have occurred.**

Photo provided by Maryland State Highway Administration (used with permission).

Figure 7: Leeds Roundabout, MD

Discussion

Implementation Issues

Maryland experienced no implementation issues with installation of the roundabouts.

Cost

The average construction cost of roundabouts is estimated at approximately $250,000[2]. Roundabouts discussed in this report ranged in cost from $194,000 to just under $500,000, depending on their size (or "footprint" and right-of-way acquisitions that were needed.)

Time Frame

Construction time for the roundabouts discussed in this report ranged from six to nine months.

Effectiveness

MDSHA conducted benefit/cost analysis that indicated that for every dollar spent, considering the 20-year service life of the roundabouts, there was a return of approximately $13 to be realized through crash reduction.

Summary of Results

The conversion of these conventional rural, stop-controlled intersections to modern roundabouts cumulatively reduced total crashes by 69.1 percent, eliminated fatal crashes, and reduced injury crashes by 88.0 percent. The average reductions in crashes achieved by the treatments are consistent with the overall estimated crash reduction of 72% and fatal/injury crash reduction of 87% for two-way, stop-controlled rural intersections mentioned in the Desktop Reference for Crash Reduction Factors (September 2007), published by the United States Department of Transportation (USDOT) FHWA[5].

References

1) 2008 Traffic Safety Facts Annual FARS, National Highway Traffic Safety Administration, Washington, DC.

2) Roundabouts: An Information Guide, FHWA-RD-00-67, Federal Highway Administration, Exhibit 5.2, pp 106, Washington, DC, June 2000. (www.tfhrc.gov/safety/00068.htm).

3) "Modern Roundabouts and the Environment," Road Commission of Washtenaw County, Michigan. (http://www.wcroads.org/news/articles/roundabouts/enviroment.htm).

4) "Roundabouts – Frequently Asked Questions," Maryland State Highway Administration. (http://www.marylandroads.com/safety/oots/roundabouts/faq.asp#Q3).

5) Federal Highway Administration. Desktop Reference for Crash Reduction Factors, FHWA-SA-07-015 (Washington, DC: September 2007), p. 30.

For More Information

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