

Safety Benefits of Replacing Traffic Signals with Modern Roundabouts– from NCHRP Report 705

By:

Jeryl (Jere) Hart, Jr., P.E., Vice-President
X⁸Environmental, Inc.

Project Panel Member NCHRP 17–35

Overview

- ▶ *Opinions expressed are my own not TRB's.*
- ▶ Results from new report: NCHRP 705
- ▶ Safety Results for Converting Signalized Intersections to Roundabouts
- ▶ Methodology of Study
- ▶ Differential Effects Based on Specific Site Characteristics
- ▶ Effects on Various Types of Crashes (PDO, Injury, Fatal)
- ▶ Most Effective Locations
- ▶ Summary

Credits and Disclaimers

- ▶ Dear Mr. Hart,
- ▶ The TRB through the National Academy of Sciences (NAS) grants permission to use from the revised final report for NCHRP Project 17-35, "Evaluation of Safety Strategies at Signalized Intersections," pages 29-32 and all of Appendix B, in a PowerPoint presentation, titled "CMF's for Conversion of Signalized Intersections to Roundabouts from NCHRP 17-35" that will be presented at the fall meeting of TexITE (Texas Section of Institute of Transportation Engineers) on September 14-16, 2011, in Garland, Texas.
- ▶ Permission is given with the understanding that inclusion of the material will not be used to imply Transportation Research Board, AASHTO, Federal Highway Administration, Transit Development Corporation, Federal Transit Administration, Federal Aviation Administration, or Federal Motor Carriers Safety Administration endorsement of a particular product, method, or practice.
- ▶
- ▶ Permission is also provided on condition that appropriate acknowledgment will be given as to the source material.
- ▶
- ▶ Sincerely,
- ▶
- ▶ Ellen Chafee, Editor- CRP-TRB
- ▶ echafee@nas.edu
- ▶ 202-334-3262
- ▶
- ▶ Source of Material is from NCHRP 17-35 "Evaluation of Safety Strategies at Signalized Intersections", Final Draft May 2011
- ▶ Source of Material is from NCHRP Report 705 "Evaluation of Safety Strategies at Signalized Intersections", August 2011
 - prepared for: National Cooperative Highway Research Program, Transportation Research Board, The National Academies

NCHRP REPORT 705

**Evaluation of Safety Strategies
at Signalized Intersections**

**Raghavan Srinivasan
Jongdae Baek
Sarah Smith
Carl Sundstrom
Daniel Carter**

UNIVERSITY OF NORTH CAROLINA HIGHWAY SAFETY RESEARCH CENTER
Chapel Hill, North Carolina

**Craig Lyon
Bhagwant Persaud**
PERSAUD AND LYON, INC.
Ontario, Canada

**Frank Gross
Kim Eccles
Ajmal Hamidi
Nancy Lefler**
VANASSE HANGEN BRUSTLIN, INC.
Raleigh, North Carolina

Subscriber Categories

Design • Safety and Human Factors

Research sponsored by the American Association of State Highway and Transportation Officials
in cooperation with the Federal Highway Administration

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2011
www.TRB.org

Results from new NCHRP Report 705

- ▶ New more reliable Crash Modification Factors for 5 Different Treatments:
 - Install Dynamic Advanced Warning Flashers
 - **Convert Signalized Intersections to Roundabouts**
 - Increase Clearance Intervals
 - Change Left Turn Phasing
 - Introduction of Flashing Yellow Arrow

Safety Results

Note: #Statistically significant
at the 0.05 level

AADT is total intersection AADT

*represents a product

Condition	Severity	CMF / CMFunction
All	All	0.792 (0.050) [#]
	All	0.00004 * AADT + 0.303
	Injury and Fatal	0.342 (0.058) [#]
2-lane	All	0.809 (0.061) [#]
	Injury and Fatal	0.288 (0.065) [#]
1-lane	All	0.735 (0.086) [#]
	Injury and Fatal	0.451 (0.115) [#]
Suburban	All	0.576 (0.053) [#]
	Injury and Fatal	0.259 (0.066) [#]
Urban	All	1.150 (0.093) [#]
	Injury and Fatal	0.445 (0.100) [#]
3 approaches	All	1.066 (0.163)
	Injury and Fatal	0.370 (0.172) [#]
4 approaches	All	0.759 (0.052) [#]
	Injury and Fatal	0.338 (0.061) [#]

Methodology of Study

- ▶ Intent to use empirical Bayes (EB) for evaluating safety impacts
- ▶ EB used to evaluate safety of converting Signalized Intersections to Roundabouts
 - 10 states but relatively small sample size
 - Good before & after data (most over 3 years)
 - Good comparable locations with no changes
- ▶ Substantial Reduction

Differential Effects Based on Specific Site Characteristics/ and Various Types of Crashes

- ▶ AADT
- ▶ Multiple states
- ▶ # of Lanes (1 vs 2)
- ▶ Number of Legs (3 or 4)
- ▶ Location– Suburban or Urban
- ▶ PDO vs. Injury/Fatality

Table 6.2. Evaluation of converting a signalized intersection to a roundabout.

Treatment: Convert Signalized Intersection to Roundabout			
METHODOLOGY: Before-After EB		CRASH TYPE STUDIED AND ESTIMATED EFFECTS	
REFERENCE: NCHRP Project 17-35		Condition, Crash Type, and Severity	No. of Improved Sites
STUDY SITES:			
<p>• Among the 28 sites, 3 were from Colorado, 1 from Florida, 3 from Indiana, 2 from Maryland, 2 from Michigan, 2 from North Carolina, 11 from New York, 1 from South Carolina, 1 from Vermont, and 2 from Washington.</p> <p>• 16 roundabouts were 2 lane and the remaining 12 roundabouts were single lane. 15 roundabouts were from suburban areas and the remaining 13 were from urban areas. 6 of the roundabouts were 3 leg and the remaining 22 were 4 leg.</p> <p>• In the before period, the average total intersection AADT was 18,529 (minimum AADT was 5,322 and maximum AADT was 43,123).</p>		All Crashes	0.792 (0.050) [#]
		All Crashes (CMFunction)	0.00004*AADT+0.303
		Injury and Fatal Crashes	0.342 (0.058) [#]
		2 lane roundabouts (all crashes)	0.809 (0.061) [#]
		2 lane roundabouts (Injury and Fatal Crashes)	0.288 (0.065) [#]
		1 lane roundabouts (all crashes)	0.735 (0.086) [#]
		1 lane roundabouts (Injury and Fatal Crashes)	0.451 (0.115) [#]
		Suburban (all crashes)	0.576 (0.053) [#]
		Suburban (Injury and Fatal Crashes)	0.259 (0.066) [#]
		Urban (all crashes)	1.150 (0.093)
		Urban (Injury and Fatal Crashes)	0.445 (0.100) [#]
		3 leg roundabouts (all crashes)	1.066 (0.163)
		3 leg roundabouts (Injury and Fatal Crashes)	0.370 (0.172) [#]
		4 leg roundabouts (all crashes)	0.759 (0.052) [#]
		4 leg roundabouts (Injury and Fatal Crashes)	0.338 (0.061) [#]
COMMENTS:			
<p>• [#] Statistically significant at the 0.05 level.</p> <p>• For total crashes, the average CMF was 0.792. However, this CMF was found to be a function of AADT and so a CMFunction was estimated. The CMFunction is valid between total intersection AADT of about 5,300 to about 43,000.</p> <p>• For injury crashes, the CMF was not found to be a function of AADT.</p> <p>• * represents a product, i.e., 0.00004*AADT is the product of 0.00004 and AADT.</p>			

Most Effective Location

CRASH TYPE STUDIED AND ESTIMATED EFFECTS

Condition, Crash Type, and Severity	No. of Improved Sites	CMF (S.E. of CMF)
Suburban (all crashes)	15	0.576 (0.053) [#]
Suburban (Injury and Fatal Crashes)		<u>0.259 (0.066)[#]</u>
Urban (all crashes)	13	1.150 (0.093)
Urban (Injury and Fatal Crashes)		0.445 (0.100) [#]

Summary

- ▶ Statistically Valid Crash Mitigation Factors (CMF's) for Replacing Traffic Signals with Roundabouts IN THE U.S. are now available from TRB (www.TRB.org) for:
 - Wide range of AADT (5,300 to 43,000)
 - 1 & 2 Lanes
 - 3 or 4 Legs
 - Urban & Suburban Locations
 - Total Crashes vs. Injury/Fatal Crashes