

An Addendum to “A Study of the Traffic Safety at Roundabouts in Minnesota”



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August 2, 2018

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Overview

In October of 2017, the Minnesota Department of Transportation (MnDOT) released a comprehensive report regarding the traffic safety performance of roundabouts in the State of Minnesota. The report was titled, “A Study of the Traffic Safety at Roundabouts in Minnesota.” Shortly after the release of the report, there has been a notice of increasing concerns and questions regarding the safety of pedestrians and bicyclists at roundabouts by MnDOT staff and other external agencies. Upon further review of the data cited in the report, an error was found with the crash data in the prior report in which the tables previously labeled “Pedestrian Crashes” and “Bicyclist Crashes” was inadvertently transposed.

Due to the overall low number of crashes, it was decided that all pedestrian and bicyclist crashes with a motor vehicle that were recorded at the 144 sites after the roundabout was built, and occurred between 2006-2015, would be read and reviewed in greater detail. Since no pedestrian or bicycle crashes occurred at roundabout intersections at interchange terminal intersections in the initial 2006-2015 review, those intersections were removed for this analysis, leaving 126 roundabout sites. After the detailed review, many of the original crashes were found to be miscoded, or located improperly, and were removed from the analysis. Reviewing the crashes and publishing accurate crash numbers and information are the main purposes of this report.

After this detailed review, the following crash data in the after roundabout construction conditions are shown in *Table 1: Frequency of pedestrian and bicycle crashes in Minnesota at 126 non-interchange roundabout sites.*

Table 1: Frequency of pedestrian and bicycle crashes in Minnesota at 126 non-interchange roundabout sites

Crash Data Years	Pedestrian Crashes	Bicyclist Crashes	Total
2006-2015	3	13	16
2016-2017	3	4	7
Total	6	17	23

The original report focused on crash data from 2006-2015. Since completion of the original roundabout report, analysis has been completed adding crash data from 2016 and 2017. One bicycle crash occurred at an interchange terminal roundabout from 2016-2017. This report will focus on non-interchange roundabouts and selected comparison intersections.

To compare these overall numbers of roundabout crashes to non-roundabout intersections, a similar set of comparable intersections was used. The comparison group consisted of 126 intersections from a variety of sites that were non-interchange intersections. This comparable group of non-roundabout intersections will be used to compare frequencies, crash rates, and crash densities of pedestrian and bicycle crashes to those calculated for the roundabout intersections.

Table 2 show the crash data regarding pedestrian and bicycle crashes at the 126 comparable intersection sites.

Table 2: Frequency of pedestrian and bicycle crashes in Minnesota at 126 comparable intersections, and the roundabout sites before the construction of the roundabout

Crash Data Years	Pedestrian Crashes	Bicyclist Crashes	Total
2006-2015	24	29	53
2016-2017	8	5	13
Roundabouts Before	2	8	10
Total	34	42	76

Calculating by Rate

These crashes have also been adjusted to account for exposure. Due to the unknown pedestrian and bicyclist exposure (intersection use by pedestrians and bicyclists), two different metrics were calculated. The first metric is using crash rate, where the number of vehicles entering the intersection is used to normalize the number of crashes. See Table 3 and Table 4 for an estimated number of vehicles entering each relative group.

Table 3: Estimated number of vehicles entering the 126 roundabouts in the two different review periods

Review Years	Vehicles Entering
2006-2015	2,128,556,505
2016-2017	853,555,527
Total	2,982,112,032

Table 4: Estimated number of vehicles entering the 126 control sites in the two different review periods, and at the roundabout sites before the construction of the roundabout

Review Years	Vehicles Entering
2006-2015	4,373,539,500
2016-2017	874,707,900
Before Roundabout	1,863,013,290
Total	7,111,260,690

When using the frequency of crashes and adjusted for the vehicle exposure, a crash rate can be calculated. The crash rate is calculated as the total number of crashes in a given time span, multiplied by one million, and divided by the total number of entering vehicles in the same time span. Table 5 and Table 6 show the calculated crash rates for pedestrian- and bicycle-related crashes at the roundabout sites and the comparable sites, respectively.

Table 5: Crash rates of roundabouts for pedestrians and bicyclists in the two review periods

Review Years	Pedestrian Crash Rates	Bicyclist Crash Rates
2006-2015	0.001	0.006
2016-2017	0.004	0.005

Table 6: Crash rates of the comparison sites for pedestrians and bicyclists in the two review periods, and at the roundabout sites before the construction of the roundabout

Review Years	Pedestrian Crash Rates	Bicyclist Crash Rates
2006-2015	0.005	0.007
2016-2017	0.009	0.006
Before Roundabout	0.001	0.004

Calculating by Density

The crash rate calculation is one method of normalizing the frequency of crashes into more directly comparable values across many intersections. The second metric used for the unknown pedestrian and bicyclist exposure was crash density.

The crash density is calculated as the total number of crashes in a given time span, divided by the number of sites and the number of years at each site added together.

See Table 7 and Table 8 for the number of site-years at each relative group.

Table 7: Number of site-years at the 126 roundabouts in the two different review periods

Review Years	Site-Years
2006-2015	690
2016-2017	248
Total	938

Table 8: Number of site-years at the 126 control sites in the two different review periods, and at the roundabout sites before the construction of the roundabout

Review Years	Site-Years
2006-2015	1,260
2016-2017	252
Roundabouts Before	430
Total	1,942

Table 9 and Table 10 shows the calculated crash densities for pedestrian- and bicycle-related crashes for each relative group.

Table 9: Crash rates of roundabouts for pedestrians and bicyclists in the two review periods

Review Years	Pedestrian Crash Rates	Bicyclist Crash Rates
2006-2015	0.004	0.019
2016-2017	0.012	0.016

Table 10: Crash rates of the comparison sites for pedestrians and bicyclists in the two review periods, and at the roundabouts sites before construction.

Review Years	Pedestrian Crash Rates	Bicyclist Crash Rates
2006-2015	0.019	0.023
2016-2017	0.032	0.020
Roundabouts Before	0.005	0.019

Analysis

Using the data points above, an average crash rate and crash density can be calculated for both roundabouts and the comparison groups.

Table 11 and Table 12 examine the average crash rates.

Table 11: Computation of the average crash rates of the roundabout sites for pedestrians and bicyclists

Description	Pedestrian	Bicyclist
Total Crashes	6	17
Total Entering Volume	2,982,112,032	2,982,112,032
Total Average Crash Rate	0.0020	0.0057

Table 12: Computation of the average crash rates of the comparison sites and sites prior to roundabout construction for pedestrians and bicyclists

Description	Pedestrian	Bicyclist
Total Crashes	34	42
Total Entering Volume	7,111,260,690	7,111,260,690
Total Average Crash Rate	0.0048	0.0059

Table 13 compares the average roundabout crash rate to the average comparison/pre-construction of the roundabout crash rate.

Table 13: Comparison of the average roundabout crash rate to the average non-roundabout/comparable sites crash rate

Description	Pedestrian Crash Rate	Bicycle Crash Rate
Average Roundabout Crash Rate	0.0020	0.0057
Average Comparable Sites Crash Rate	0.0048	0.0059
Difference (Roundabout to Comparisons)	-57.9%	-3.5%

Table 14 and Table 15 examine the average crash densities.

Table 14: Computation of the average crash densities of the roundabout sites for pedestrians and bicyclists

Description	Pedestrian	Bicyclist
Total Crashes	6	17
Total Site-Years	938	938
Total Average Crash Density	0.006	.018

Table 15: Computation of the average crash densities of the comparison sites and sites prior to roundabout construction for pedestrians and bicyclists

Description	Pedestrian	Bicyclist
Total Crashes	34	42
Total Site-Years	1,942	1,942
Total Average Crash Density	0.018	0.022

Table 16 compares the average roundabout crash density to the average comparison/pre-construction of the roundabout crash density.

Table 16: Comparison of the average roundabout crash density to the average non-roundabout/comparable sites crash rate

Description	Pedestrian Crash Density	Bicycle Crash Density
Average Roundabout Crash Density	0.006	0.018
Average Comparable Crash Density	0.018	0.022
Difference (Roundabout to Comparisons)	-63.5%	-16.2%

Based on these crash frequencies, crash rates, and crash densities, it appears that roundabouts are not presenting an overall greater risk to pedestrians and bicyclists in regards to collisions with motor vehicles. Based on an approximate 60% reduction in crash rates and crash densities, roundabouts may be offering an overall higher performance of pedestrian safety.