Traffic Circles for Residential Intersection Control: A Comparison with Yield Signs Based on Seattle's Experience

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ABSTRACT

The city of Seattle has used more traffic circles than yield signs or stop signs to control four-way residential intersections in the past 10 years. The purpose of these traffic circles is to respond to above-average accident problems at neighborhood intersections without having to rely on the use of yield signs and stop signs. It was found in this study that both traffic circles and yield signs can reduce the number of intersection collisions by about 77 percent. Information reviewed for this study indicates that traffic circles can reduce midblock speeds by significant amounts. Locations with traffic circles reveal a variety of changes in volume after a circle has been placed. These changes are likely to be caused by other conditions in the neighborhood rather than by the circle. A total volume decrease of 2 percent (an insignificant change) was measured for 20 traffic locations. Similar data were not available for stop-sign and yield-sign locations. The cost for a traffic circle is much higher than for a yield sign, but if a city is willing to incur additional costs, circles can reduce the proliferation of traditional control devices, perhaps enhancing the effectiveness of signs elsewhere.

The Seattle Engineering Department is using traffic circles in residential intersections in which accidents occur but usually do not occur enough to warrant the installation of yield signs or stop signs according to criteria used by the city of Seattle.

Examples of traffic circles installed in Seattle's neighborhoods are shown in Figure 1. These devices are simple, round-raised islands placed in the middle of intersections. Circle details are shown in Figure 2. Seattle had approximately 150 intersections with traffic circles at the end of 1983. Although other cities throughout the United States have used an occasional traffic circle in residential intersections, Seattle has developed the most extensive system of traffic circles in the country. In the past 10 years there have been more residential intersections in Seattle equipped with traffic circles than intersections equipped with new yield signs or stop signs.

The rules of the road at intersections with traffic circles are the same as at any other unsignalized intersection. The driver on the right has the right-of-way. Cars turning left may turn left in front of the circle or go around it counter-clockwise. If the situation warrants a change from this then KEEP RIGHT signs are installed.

The purpose of this study was to make quantitative and qualitative comparisons between traffic circles and yield signs. A group of 14 traffic circle locations in Seattle was studied in 1980 (1). The results indicated that the installation of traffic circles had reduced the number of accidents more than 90 percent. However, there was no comparison of a similar reduction caused by the installation of yield signs. At the time of this 1980 study, there were not enough data to determine the effects of traffic circles.

SEATTLE'S POLICIES FOR NEIGHBORHOOD TRAFFIC CONTROLS

To respond to a request or concern about a neighborhood traffic problem, a member of the Seattle Engineering Department staff will look at the accident records for the past 3 to 4 years to determine the number and type of collisions occurring at the location under investigation. If numerous accidents have been reported in the past 3 years, then a visit to the site usually follows.

A site visit might reveal problems such as overgrown vegetation, cars parked too close to the corner, or other problems that may be corrected by

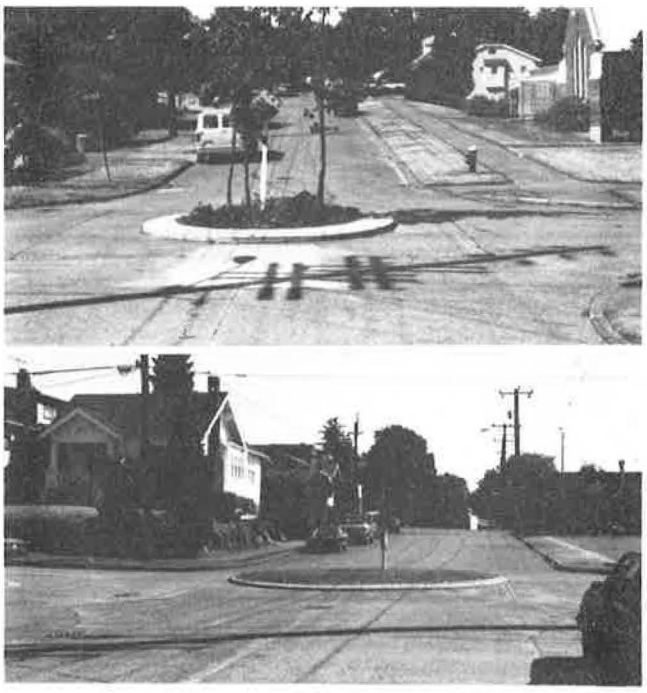

FIGURE 1 Example of traffic circles in Seattle.

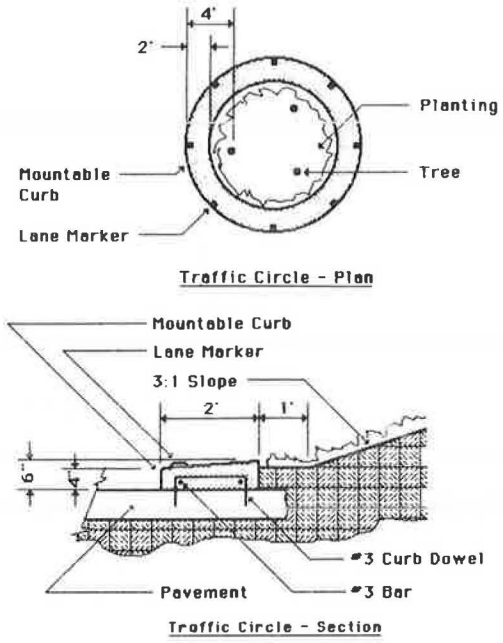

FIGURE 2 Traffic circle details.

some type of action other than installing additional control at the intersection. If there is nothing that is obviously causing problems, then a traffic circle may be recommended.

The procedure used to determine if a circle will be installed requires the neighborhood's support in the form of a petition or mail-back survey to show a majority vote in favor of placing a circle at a particular location. Once this support is shown, additional information is then collected to determine the number of reported accidents over the past 3 years, to measure the 85th percentile speed on one midblock section of the street next to the intersection, and to count the number of vehicles using the major street. This information is used to rank locations in order of problem severity.

The Seattle Engineering Department attempts to put controls that cause the least amount of delay and restriction needed to reduce accidents at four-way residential intersections. Other cities will install yield signs or stop signs at locations based on volumes, sight distance, or number of accidents (2,3). As a result, these cities eventually will have almost every four-way intersection controlled by stop signs or yield signs. It is practices such as these that have caused a widespread use of yield and stop controls at four-way residential intersections.

Rather than reduce the number of accidents to the level required to install yield or stop signs in order to address problem intersections, Seattle has chosen to use traffic circles as a control device that helps prevent accidents from occurring at four-way residential intersections. The use of traffic circles has also provided additional benefits such as significant speed reductions and the ability to respond to the concerns of citizens about traffic safety without having to use yield signs and stop signs.

DATA COLLECTED

Data used in this study were found in the existing files of the Transportation Division of the Engineering Department. The data collected were analyzed for groups of locations that have the same type of control device. Differences between intersections controlled with traffic circles and those controlled by yield signs are determined quantitatively when sufficient before-and-after data exist for each group of locations.

Selection of Intersections

The intersections studied in this project had the following characteristics:

1. Four-way local access street intersection,
2. Primarily residential land use,
3. Change in control between January 1, 1974 and December 31, 1983.

A list of locations that had received new yield signs within the past 10 years was generated from the Engineering Department computer records for traffic signs. Locations that did not meet the criteria previously listed were removed from the list.

Information for traffic circle locations was found in records kept by the Engineering Department. A file is maintained for each intersection. A master list of all circle locations was compiled from these records.

Accidents

A reportable accident in Seattle is defined as a collision that causes $300 or more damage. Information for these accidents is kept on computer tapes and is available for accidents that have happened since January 1, 1974.

Because of the varying installation dates, before-and-after study periods for every location could not be the same. Therefore, to study locations with a reasonable amount of before-and-after accident data, locations studied were chosen for which at least 3 years of before data and 3 years of after data were available.

Speeds

The Engineering Department collects speed information near each intersection before a traffic circle is installed. This information is evaluated to rank intersections that are to receive circles the following year.

After a circle has been in place for at least 6 months, a second speed survey is done at the same location. No studies have been conducted in Seattle to determine the effects of yield signs on speeds.

Volumes

Seattle collects volume information to help assign priorities to locations proposed for traffic circles. An automatic counter is put across one of the legs of the intersection for 7 consecutive days. An average weekday traffic (AWDT) value is determined for the volumes counted on the 5 weekdays.

The volumes are usually measured on the street with the higher amount of traffic. The higher volume street is chosen based on previous short-term counts or from information gathered from nearby residents.

After a circle has been in place for several months, a second automatic count is taken at the same location as the previous count. The before-and-

after AWDTs are then adjusted with a seasonal factor to eliminate variations between months of a particular year. The adjusted AWDTs are then compared to determine any changes in volumes occurring on the higher volume street.

DATA ANALYSIS AND RESULTS

Intersection Accidents

To compare the accident experiences at controlled four-way residential intersections, accident totals were generated over the same 10-year period using the following control devices:

1. Yield signs--a group of 65 intersections at which yield signs have been installed between January 1, 1974, and December 31, 1978; and
2. Traffic circles--a group of 38 intersections at which traffic circles were installed between January 1, 1971, and December 31, 1980.

The accident totals were used to determine the average number of reported collisions occurring at these types of intersections during each year from 1974 through 1983. The compilation of accident data over 10 years resulted in the following observations from 1974 to 1983 in Seattle:

1. Uncontrolled four-way intersections averaged about 0.5 accident per year,
2. Yield-sign-controlled intersections averaged between 0.8 accident per intersection each year after 1979 when all 65 locations had yield signs in place, and
3. Traffic-circle-controlled intersections averaged about 0.1 accident per intersection each year after 1980 when all 34 locations had circles in place.

These figures can only be used for trend comparison because the volumes are vastly different for each type of control device.

By reviewing the policies that Seattle uses to place the control devices being discussed, it is expected that proposed locations for yield signs will have higher accident averages before being controlled than intersections selected for traffic circles. To determine those averages and the reductions caused by using these controls, the following data were analyzed: (a) before-accident averages for 1, 2, and 3 years before installing each device, and (b) after-accident averages for 1, 2, and 3 years after each device was installed.

Intersections that had yield signs and traffic circles installed between January 1, 1977, and December 31, 1980, were used for this portion of the study. There were 41 yield-sign intersections and 40 traffic-circle intersections that met these criteria. The results of these before-and-after comparisons are shown in Figures 3 and 4. Results of use of both devices show a 77 percent reduction in number of accidents.

Midblock Accidents

Accidents occurring in all of the four approaches were tabulated for various locations that have the two types of controls. This information was averaged over various before-and-after time periods determined by installation date of the control device at the intersection. The results of this data analysis are given in the following table (note that the data

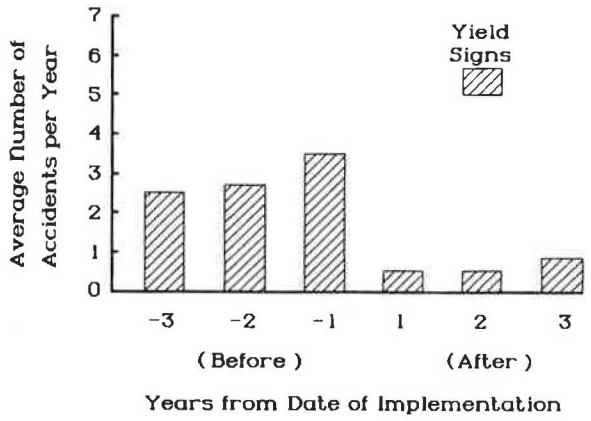

FIGURE 3 Before-and-after accidents at locations using yield signs.

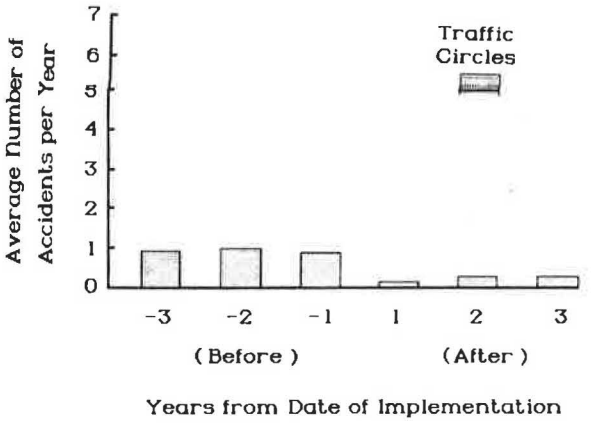

FIGURE 4 Before-and-after accidents at locations using traffic circles.

are the yearly average for four intersection approaches):

	No. of Accidents		Reduction
	Before	After	(%)
Yield	0.70	0.63	10
Circle	1.03	0.63	39

All reductions are significant at $\alpha = 0.05$.

Speeds

In Seattle there is little if any information collected about speeds when yield signs are installed at residential intersections. The literature search done for this study did not reveal any studies conducted with yield signs to determine effects on midblock speeds. The FHWA study done in 1981 concluded that the yield-controlled intersections produced the shortest travel times through an intersection when compared with stop-controlled and uncontrolled locations (3). Without collecting and analyzing additional before-and-after speed data it would be difficult to state that yield signs could significantly decrease midblock speeds.

Seattle has some documentation on before-and-after speeds near intersections with traffic circles. A search through files produced a sample of 10 locations that had speed studies with large numbers

of cars and with the same location used for both the before-and-after speed surveys.

At 9 out of 10 traffic circle locations studied, there were decreases in midblock speeds. All of these decreases were statistically significant. The before-and-after speeds are shown in Figure 5.

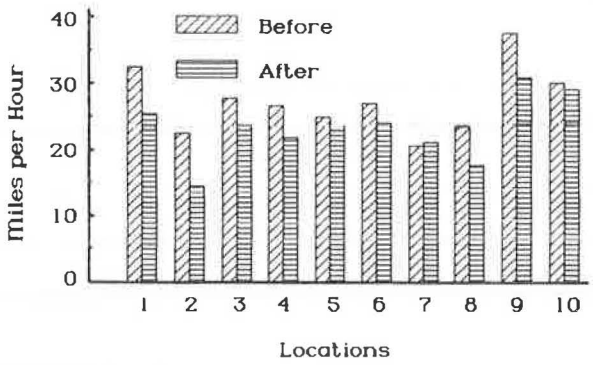

FIGURE 5 Before-and-after midblock speeds at 10 traffic circle locations.

Volumes

Volume information is collected for each location being considered for a traffic circle. For this study, a group of 20 traffic circle locations was used to determine the changes in volumes. These circles were installed in 1983 and had complete records for both before-and-after volumes. There was no before-and-after volume information collected for the yield sign locations studied.

Numbers used for comparisons represent the AWDT volume for the major street. The counts were adjusted for monthly differences.

Of the 20 locations analyzed, 9 locations had increases and 11 locations had decreases after traffic circles were installed. The group as a whole had a decrease of 2 percent in the total volume.

Costs

Another difference about the use of traffic circles is that these devices cost much more than two signs. Construction costs for a traffic circle with landscaping are $3,400; total costs including planning and engineering are $5,550. A pair of yield signs or stop signs costs about $500. It would not be appropriate to compare the cost of installing a traffic circle at a particular location with the cost of installing yield signs or stop signs at the same location. It is obvious that signing would be the less expensive alternative. However, if one values the reduction of the number of traffic control signs in residential areas, traffic circles may be worth the added expense. In some cases people in the neighborhoods have contributed funds to install traffic circles.

CONCLUSIONS

Conclusions drawn from the data analysis and literature review are as follows:

1. Accident reductions: (a) traffic circles are shown to have accident reductions of 77 percent when comparing 3-year before-and-after totals of intersection accidents, and (b) yield signs also have shown a reduction of 77 percent.
2. Midblock speeds: Traffic circles tend to significantly decrease the speeds of vehicles downstream of intersections with circles.
3. Volumes: Locations with traffic circles tend to show a wide range of volume increases and decreases, but the locations studied in this paper had an overall decrease of 2 percent, which is insignificant.
4. Costs: Installation of a traffic circle at a residential intersection costs much more than installation of either a pair of stop signs or a pair of yield signs.

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