Responding to Citizen Requests for Multiway Stops

BY PATRICIA B. NOYES

The use of multiway stops for speed control is a subject that has received a great deal of attention from citizens and far too little conclusive discussion by traffic engineers. In an effort to address the ongoing surge of citizen requests to install four-way stops for speed control, the staff of the Boulder (Colo.) Transportation Division completed a literature search on the use of multiway stops and conducted local studies on their effectiveness and driver compliance. The purpose of this study was to identify the issues related to the use of multiway stops and to help citizens understand some of the negative side effects of their use. The effort was intended to develop an information piece that could be used in discussions with citizens. The remainder of this article is intended for that use and can be used as a basis for other local efforts to develop public information strategies.

Considerations for the Installation of Stop Signs

Multiway stop signs usually are requested to address speeding and safety problems in residential areas. Boulder's studies on compliance and speed were an attempt to examine the effectiveness of stop signs for these uses. In addition to these issues, there are several other areas that need to be examined and discussed in considering the use of multiway stops. A number of these are outlined below.

Conversion Factors		
To convert from	to	multiply by
ft	m	0.3048
mph	kmh	1.609

Compliance

Stop signs are used to improve the safety of an intersection by assigning right-of-way; therefore, compliance with stop signs is essential for their effectiveness. Several studies have shown that in situations where stop signs are installed but are not warranted, based on nationally adopted standards, there is a low level of compliance. In these cases, motorists were observed either rolling or running a stop sign. When a driver does not believe that a restrictive sign appropriately reflects the conditions, the driver often disregards it.

This was studied in Boulder and the results are summarized in Table 1. Stop sign compliance studies were completed at nine four-way and four three-way stop locations. Of the 900 cars observed at the four-way locations, 23 percent made a full stop. Of the 350 vehicles observed at three-way locations, 7 percent stopped. The majority of the observed cars at all locations made a rolling stop (slowed to less than 3 miles per hour (mph) but did not come to a complete stop).

The highest compliance levels occurred at the higher volume, four-way stop locations. The three locations that significantly exceeded the average compliance rate involved higher volumes with higher percentage side street traffic. These locations experienced 39 percent to 40 percent compliance. The one other location that exceeded the average compliance level experienced 26 percent compliance. This location would require tree trimming for sight distance in order to remove the stops from the main street.

Three-way stops showed the lowest compliance with 11 percent of the 350 cars observed driving through the stop sign in excess of 3 mph.

Speed Control

There is a common belief among the general public that stop signs provide relief from traffic speeding problems. On the face, it would appear reasonable that when approaching a stop sign, motorists have to slow down. However, studies conducted nationwide have shown that the speeds within a block of the stop sign are either unaffected by the stop sign or, in some cases, actually increase. At the point of installation, speeds are reduced, but the effect on traffic approaching or leaving the controlled location is negligible. Some motorists actually increase their speed to make up for the inconvenience.

Speeds approaching and downstream of multiway stop signs in Boulder were studied are summarized in Table 2. Speed studies were conducted an average of 500 feet (ft) from the stop sign on the approach to, and downstream from, four four-way and two three-way stop locations. The average 85th percentile speeds (85 percent of the vehicles traveled that speed or less) were 35 mph on the approach and 34

Table 1. City of Boulder Stop Sign Compliance Study

	Stop Sign Compliance			
Four-Way Stops *Location* *Date/Time*	*Stop %*	*Roll %*	*No Stop %*	*Total Observed*
Maxwell & 9th 6-20/3:30-3:39	21	75	4	100
Manhattan & Illini 6-19/4:30	26	71	3	100
Alpine & 13th 6-19/3:42-3:58	39	60	1	100
Balsam & 19th 6-19/3:30-3:38	40	59	1	100
Walnut & 33rd 6-19/3:12-3:22	19	79	2	100
Arapahoe & 6th 6-19/2:50-3:05	39	60	1	100
Wonderland & Poplar 6-29/8:08-8:40	11	82	7	100
Brooklawn & Laurel 6-28/4:20-5:05	7	88	5	100
College & 7th 6-29/4:20-5:30	6	79	15	100
Average Compliance	23	73	4	900
Three-way Stops				
Kalmia & 26th 6-20/3:47-4:14	9	76	15	100
Gallaspie & Julliard 6-22/4:00-4:55	11	80	9	100
Albion & Toedtli 6-26/4:30-5:30	8	82	10	50
Manhattan & Cimmaron 6-21/4:33-5:15	2	89	9	100
Average Compliance	7	82	11	350

mph downstream from the stop sign. The mean vehicular speeds were 31 mph and 30 mph, respectively.

Two of the six locations were posted 30 mph and the others were posted 25 mph. The average 85th percentile speed for the 30 mph locations was 36 mph and the mean speed was 32 mph. The average 85th percentile speed for the 25 mph locations was 34 mph and the mean speed was 30 mph. These are comparable or greater than speeds observed on other Boulder residential streets.

Safety

Studies have shown differing effects on accident rates at intersections before and after the installation of multiway stops. In some cases the accident rates

increased, in others they decreased and in still others there were no significant changes. General engineering belief is that the unwarranted use of stop signs potentially decreases safety at the intersection because of the disregard of these controls as observed in the compliance studies; however, no study has definitively proved this. A recent article on Chicago's (Ill.) experience with the use of multiway stops indicates that the accident rates might be reduced at low-volume intersections (see LaPlante and Kropidlowski[1]).

Motorist Delay

The unwarranted use of stop signs increases vehicle delay. Where the proper use of multiway stops occurs, the increase in delay on the main street is offset somewhat by the reduced delay on the side street. However, in an unwarranted situation, there is minimal delay on the side street and overall delay is increased significantly by the required stop of all traffic on the main street.

Excessive Restrictions on the Public

The unwarranted use of stop signs creates excessive restrictions on the motoring public. This creates a great deal of frustration and, as previously mentioned, disrespect for traffic control devices. It also is contradictory to the legislative intent of the Uniform Vehicle Code and Model Traffic Ordinance 1987, which states that, "The proper purpose of all traffic legislation is not to impose unnecessary or unreasonable restrictions on highway traffic, but to insure, as far as this can be done by law and its application, that traffic shall move smoothly, expeditiously and safely."

The motto of the committee is "Safety with Freedom Through Law," which summarizes its philosophy "to provide to every highway user, through law, a maximum degree of safety within the framework of traditional freedoms."

The *Traffic Control Devices Handbook* states, "The most effective traffic control device is that which is the least restrictive while still accomplishing the intended purpose."[2]

Environmental Effects

The unwarranted use of stop signs affects the environment in terms of air pollution, noise impacts and fuel consumption.

Air Pollution

The effects of stopping and idling increase automobile exhaust. A study of 10 four-way stop intersections in Michigan found: "The total additional emissions of carbon monoxide were 1,287,500 pounds per year, hydrocarbons totaled 79,200 pounds per year and oxides of nitrogen totalled 83,000 pounds per year. These quantities indicate the magnitude of the additional emissions attributable to four-way stop sign control at these intersections."

Noise Impacts

Additional traffic noise also is associated with stopping and starting. Braking and acceleration increase tire noise and engine noise. Stop signs also increase the amount of time any one vehicle is at a particular point. Therefore, residents living near the stop controlled intersection will experience an increase in traffic noise.

Fuel Consumption

Stopping, accelerating and idling also increase the amount of fuel consumed by a vehicle. A California study in 1982 found that deceleration and acceleration for each stop an average passenger car makes, 0.0173 gallons of fuel is consumed. This would mean that for every unwarranted stop sign installed on a street with 10,000 cars per day, 173 additional gallons of gasoline would be consumed in a day, or 63,145 additional gallons would be consumed in a year.

Pedestrian Exposure

Although it is commonly believed that stop-controlled intersections provide increased safety for pedestrians, this might not be accurate at locations where adequate gaps in traffic exist and the stop signs are unwarranted. If a stop sign is installed under these conditions, a vehicle is present at the intersection for a much longer period while it slows, stops and accelerates. This actually causes an increase in the exposure time

Table 2. City of Boulder Speed Study

	Speed Studies	
Stop Location Street/posted speed	*Approach Speed 85th% Average*	*Downstream Speed 85th% Average*
Balsam & 19th	38	39
19th Street/30 mph	33	35
Walnut & 33rd	35	32
Walnut/30 mph	31	29
Brooklawn & Laurel	33	32
Brooklawn/25 mph	30	29
Arapahoe & 6th	33	31
Arapahoe/25 mph	29	28
N. 26th & Kalmia	37	37
N. 26th/25 mph	32	32
Gillaspie & Emerson	33	32
Gillaspie/25 mph	29	29
Average 85th	35	34
Mean Speed	31	30

100 Observations were made at each location, 50 each direction.
Speeds were shot 400ft.-600 ft. from stop sign.

of the pedestrian to vehicles and reduces or eliminates the natural gaps in traffic at the intersection by increasing the time each vehicle is present.

The other major exposure issue is that of the pedestrians to drivers who will violate the stop control. As has been observed, compliance at unwarranted stops is low and this leaves pedestrians vulnerable to these violations. This presents a particular hazard to children, whose size might make them less immediately visible to drivers.

Clarity of Traffic Control

Traffic control devices are designed to inform drivers of roadway and traffic conditions with minimal opportunity for confusion or misinterpretation. Stop signs are used to assign right-of-way to a through street by stopping traffic on the minor street. The motoring public expects the uniform application of traffic control devices and would not expect a stop sign on the major street. This potential for confusion aggravates the observed compliance problem and cre-

ates a potential safety hazard.

Legal Responsibilities

Variations from accepted warrants without documented exceptional conditions present potential liability concerns for the responsible jurisdiction. If a stop sign installation could be considered irresponsible or in clear contradiction to accepted standards, liability suits could result.

Summary

Existing studies and information on the use of multiway stop signs are far from conclusive. There are however, a variety of studies that provide some important insights into their use. The recent article by LaPlante and Kropidlowski provides a comprehensive review of the use of accident experience associated with the use of multiway stop signs. It recommends that the existing *Manual on Uniform Traffic Control Devices* warrants for multiway stops be reviewed and potentially revised to address local residential streets in urban areas more effectively. Although a review of the warrants might be appropriate, it should be done with respect to a variety of implications.

The issues for consideration discussed in this article include:

- Compliance
- Speed Control
- Safety
- Motorist Delay
- Excessive Restrictions on the Public
- Environmental Effects
- Pedestrian Exposure
- Clarity of Traffic Control
- Legal Responsibilities

These issues should be included in any discussion on the use of multiway stop signs. This list and the discussion of these issues is an attempt to open the discussion in a way that helps engineers and citizens alike examine the implications of using multiway stops. There are certainly other concerns that could be added to this list based on the experience of others.

The engineering community and the public need to consider all of the implications of multiway stop sign use and continue to study the impacts of their use so in order to work together to appropriately address specific traffic control issues.

References

1. LaPlante, John N. and Chester R. Kropidlowski. "Stop Sign Warrants: Time for Change." *ITE Journal*, Vol. 62, No. 10 (October 1992): 25-29.
2. U.S. Department of Transportation. *Traffic Control Devices Handbook*. Washington, DC: Federal Highway Administration, 1983.

Bibliography

American Traffic Safety Services Association Inc. *ATSSA Newsletter*, 1989.

Baumgaertner, William E. "In Search of Effective Speed Control." *Institute of Transportation Engineers Technical Notes*, December 1980, 12-16.

Beaubien, Richard F. "Citizen Participation in Traffic Safety." *ITE Journal*, Vol. 52, No. 3 (March 1982): 29-31.

Beaubien, Richard F. "Controlling Speeds on Residential Streets." *ITE Journal*, Vol. 59, No. 4 (April 1989): 37-39.

Beaubien, Richard F. "Stop Signs for Speed

Control?" *Traffic Engineering*, November 1976, 26-28.
Briglia, Peter M., Jr. "An Evaluation of 4-Way Stop Sign Control." *ITE Journal*, Vol. 52, No. 8 (August 1982): 16-19.
Chadda, Himmat S. and Everett C. Carter. "Multi-Way Stops—Have We Gone Too Far?" *ITE Journal*, Vol. 53, No. 5 (May 1983): 19-21.
Holmburger, Wolfgang S., et al. *Residential Street Design and Traffic Control*. Englewood Cliffs, NJ: Prentice-Hall, 1989.
"Indiana Suggests Ways to Halt Stop Sign Misuse." *TRANSAFETY Reporter*, Vol. VII, No.2 (February 1989): 7.
Lum, Harry S. and Martin R. Parker Jr. "Intersection Control and Accident Experience in Rural Michigan." *ITE Journal*, Vol. 53, No. 5 (May 1983): 27-29.
National Committee on Uniform Traffic Laws and Ordinances. *Uniform Vehicle Code and Model Traffic Ordinance*, 1987.
U.S. Department of Transportation. *Manual on Uniform Traffic Control Devices*. Washington, DC: Federal Highway Administration, 1988. ▮

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