

SURVEY ON USE OF 4-WAY AND REVERSED STOP SIGNS
IN RESIDENTIAL AREAS

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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SUMMARY

A nationwide questionnaire survey on use of 4-way stop signs and reversed stop signs to reduce through traffic in residential areas elicited responses from 141 governmental agencies including state highway departments, urban counties containing cities with a population of more than 150,000, and cities with a population of over 400,000.

A tabulation of the responses showed that the public seems to favor the use of 4-way stop signs to discourage through traffic, though they are unwarranted by the MUTCD. The unwarranted 4-way stop sign is not recommended by most government agencies, but they use it because of public demand or political pressure. The survey showed that it may be possible to reduce MUTCD warrants for residential streets.

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INTRODUCTION

Complaints from residents about through traffic in their neighborhoods and the techniques used by governmental agencies to reduce these complaints have been the subject of controversy. The most economical means known to have satisfied public demand are 4-way stop signs and stop signs placed on the major road carrying the through traffic rather than on the minor road. Such signing practices are known to be widely used in this country though they may or may not meet the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) of federal and state agencies. A questionnaire survey was made to determine whether the 4-way and reversed stop signs could be used to advantage in Virginia. This is the initial report on the research.

PURPOSE

The purpose of this report is to provide a summary of the answers to a questionnaire sent out by the author to cities, counties, and state highway and transportation departments. Conclusions and comments are included.

QUESTIONNAIRE SURVEY

Two questionnaires (see Figure A-1 in Appendix) on the use of the 4-way and reversed stop signs to reduce through traffic were sent to 242 government agencies, including 49 state highway departments and Washington, D. C., 134 urban counties containing cities with a population of more than 150,000 and 58 cities with a population of over 400,000. Responses were received from 141 agencies. Questionnaire 1 pertained to the use of 4-way stop signs and questionnaire 2 to the use of stop signs on the major roads carrying through traffic in residential areas, rather than on the minor roads.

Tables A-1, A-2 and A-3 of the Appendix give summaries of the answers to the questionnaire on the use of 4-way stop signs. Table A-4 is a summary of the tables A-1, A-2 and A-3. Of the 141 agencies who answered the questionnaire on the reversal of the stop signs from the minor road to the major road, 126 said that they were not using this practice. The answers from the 15 agencies who were using this practice or who had experience with it are given in Table A-5.

RESPONSES TO QUESTIONNAIRE NO. 1

The following is a review of the responses to each question in questionnaire No. 1.

Number of 4-Way Stop Signs Installed

Of the 141 agencies who answered the questionnaire, 112 had used the 4-way stop signs. The breakdown is shown in Table A-4. The number of installations under state jurisdictions varied, with the maximum of about 350 being in Nebraska. The highest number used in any one county was 118 in Sacramento County, California. In cities use of these signs seems to be prevalent. The highest number reported in use by a city was 1,850 in Philadelphia. The second highest number reported was 700 in residential areas in Chicago. For residential areas, the average numbers used are 53 for states, 15 for counties, and 171 for cities. For business areas the average numbers used are 22 for states, 6 for counties, and 17 for cities. Thus the 4-way stop signs are used mostly in residential areas. The numbers of MUTCD warranted signs are not known, but as is evident from the answers, it appears that under the state jurisdictions most of the signs are, though in many cases the installations have been made in response to public demand or political pressure, especially in the counties. In cities the installations in residential areas have resulted mostly from public demand.

What Percentage of Drivers Stop at Stop Signs?

The average percentages of drivers failing to stop at 4-way stop signs were reported to be 17% for residential areas and 9% for commercial areas. National Cooperative Highway Research Project 3-6 found that for the conventional 2-way stop signs during peak-hour traffic very small numbers of vehicles (about 1% to 9%) come to a voluntary full stop, while the majority of vehicles (47% to 57%) proceed through at speeds between 0 and 5 mph and

5% to 6% proceed at speeds above 5 mph. Union County, New Jersey, has reported that for conventional 2-way stop signs, 56% of the vehicles come to a full stop, 40% come to a rolling stop, and 4% do not stop; while for 4-way stop signs, 48% came to a full stop, 40% to a rolling stop, and 12% do not stop.(1)

From the above data it is evident that conventional 2-way stop signs as well as 4-way stop signs do not induce 100% of the motorists to come to a full stop, and that for the percentage of motorists observing the law for 4-way stop signs is slightly less than that for 2-way conventional stop signs. The high percentages of motorists not observing stop signs is very alarming, and shows the dangers of depending on stop signs for the safety of pedestrians. This danger increases with the installation of 4-way stop signs as compared to conventional 2-way stop signs.

The Confusion as to Who Has the Right-of-Way

The agencies were asked to grade the confusion caused by 4-way stop signs as to who has the right-of-way in the three categories of low, medium, and high. The average gradings were as follows:

Low confusion	79 agencies = 81%
Medium confusion	14 agencies = 15%
High confusion	4 agencies = 4%

Based on the above information it could be concluded that not enough confusion is caused by 4-way stop signs to justify discontinuing their use if they are found to be otherwise beneficial.

Average Number of Accidents Per Intersection Per Year

The agencies were asked to give an approximate number of accidents per intersection per year. Some supplied these data from actual counts while most estimated numbers based on their knowledge. The number of accidents per intersection per year reported by different agencies varied from none or less than 1 to more than 4. The average was 2 for all the agencies.

Many agencies reported that the 4-way stop signs had reduced accidents. The Hawaii Department of Highways, which had only one 4-way stop sign in a residential area, claimed that the accidents decreased from 12 per year to 1 per year after the installation. The Michigan Highway Department claimed a dramatic decrease in

accidents and casualties. Genessee County, Michigan, claimed a dramatic reduction in accidents at fairly high traffic volume intersections. Onida County, New York, claimed that accidents were minimized. Dane County, Wisconsin, also claimed accident reductions. In Anne Arundel County, Maryland, one of three locations showed a marked decrease in accidents after the installation of 4-way stop signs, while the other two maintained their accident patterns.⁽²⁾ Suffolk County, New York officials claimed that they reduced accident severity though the accident rate increased. Clark County, Nevada, found that the accidents increased with increased traffic and deviations from prescribed warrants. The Oregon Highway Department determined that in changing from 2-way to 4-way stop signs the type of accidents seemed to change from right angle collisions at 2-way stop signs to rear end collisions at 4-way stop signs.

It is, therefore, apparent that 4-way stop signs in many cases do reduce accidents and accident severity but as discussed before the stop signs should not be relied upon to stop all motorists.

The Average Approximate Cost of Total Damage Per Accident

The approximate cost of damage per accident at 4-way stop sign locations as reported by the agencies varied from \$50 to \$500. The average approximate cost per accident was \$307.

Approximate Number of Legal Involvements for All Such Accidents

Some engineers are of the opinion that it is very difficult for the enforcing agencies to determine which party is at fault when a collision occurs at a 4-way stop intersection and results in a legal involvement. To clarify this point, the agencies were asked to categorize the approximate number of legal involvements for all such accidents as "none, a few, or many." Of the agencies responding, 39 (56%) reported no legal involvement; 30 (43%) reported a few legal involvements; and 1 agency (1%) reported many legal involvements. Thus the legal involvements were found to be very few.

Evaluation of the Comments by the Replying Agencies

The comments given by the replying agencies are summarized in the last column of Tables A-1, A-2, and A-3 of the Appendix and are interpreted below.

1. There is a great difference of opinion between neighborhood residents and governmental agency officials. Residents seem to favor the use of 4-way stop signs to discourage through traffic, even though the signs may not satisfy MUTCD warrants. Government agency officials report that the residents' complaints fall off after the installation of the 4-way stop signs. However the officials believe that the 4-way stop signs do not reduce speed and do not command respect. They are not observed to a degree that 2-way stop signs are and thus can give a false sense of security. In addition air and noise pollution are due to increased quick braking or quick accelerating at the stop signs and intersection efficiency is reduced.
2. The 4-way stop signs seem to reduce accidents at certain locations, probably where a view of the crossing traffic is blocked because of the horizontal or vertical road alignment or obstructions such as cars parked along the curb.
3. No agency has complained about litigation as a result of the use of unwarranted 4-way stop signs. However, there is a good possibility that in jurisdictions where laws permit litigation by the road user against government agencies for the recovery of damages suffered there is a need for strict adherence to MUTCD warrants. A good example is a court trial due to an accident in the small resort community of Wolverine Lake, Michigan, in which the plaintiff was awarded half a million dollars from the village. One of the reasons was that the signs were not in conformance with the MUTCD.(3)

Montgomery County, Maryland, officials commented that their research had shown that the MUTCD warrants were not applicable to residential areas. This might be true and the MUTCD warrants probably are based on experience on highways and urban streets. Government agencies that have to prevent litigation and at the same time respond to public demand may find it necessary to enact ordinances to modify the MUTCD warrants to suit the requirements of their residential streets. An example is Anne Arundel County, Maryland, which has reduced traffic volume warrants in its subdivision regulations as shown in Table 1.(2)

Table 1

Traffic Volume Warrants for Primarily Residential
Streets in Anne Arundel County, Maryland

Total Volume	500 VPH for 8 hours	400 VPH for 6 hours
Minor Street Volume	200 VPH for 8 hours	160 VPH for 6 hours
Split	60% — 40%	60% — 40%

Chicago has also reduced its traffic volume warrants. Its split factor — a ratio of the major street volume to the minor street volume is about 2:1 instead of 3:2 as shown in Table 1. Officials there claim to have used this system for many years with no complaints from residents.⁽⁴⁾ Chicago is the biggest user of 4-way stop signs, with 700 installations in residential areas and 50 in business areas.

Decreasing the total volume of traffic negotiating the intersection and increasing the split factor will help to reduce the warrant requirements. The governmental agencies could then adopt the reduced warrants for application to their residential streets and thus reduce public complaints.

RESPONSES TO QUESTIONNAIRE NO. 2

Of the 141 agencies who answered the questionnaire, 16 had had experience in reversing the stop sign from the minor road to the major road in residential areas. A summary of the answers to questionnaire No. 2 are given in Table A-5. The number of installations varied from 1 in Alameda, California to 200 in Chicago. Clark County, Nevada had used arrangement at about 100 intersections. It was reported that 72% of the drivers stopped at the reversed stop signs as compared to 83% at the 4-way stop signs in residential areas. The average number of accidents per intersection per year was 2.5 as against 2.0 for the 4-way stop signs. The approximate average cost per accident was \$291 as against \$307 for the 4-way stop intersection. Of the agencies responding, 62% reported no legal involvement as against 56% for the 4-way stop signs; 38% reported a few legal involvements as against 43% for 4-way stop signs; and none reported many legal involvements as against 1% for 4-way stop signs.

It could, therefore, be concluded that the observance of stop signs, the percentage of accidents, total cost per accident, and legal involvements for reversed stop signs were almost the same as for the 4-way stop signs.

The 4-way stop signs have one safety advantage over reversed stop signs; they stop the traffic on the minor road too.

Union County, New Jersey which once used the sign reversal arrangement has now abandoned it. Lucas County, Ohio discourages use of the arrangement. Philadelphia, which had used the reversed signs at several dozen locations has converted them to 4-way stop signs. Clark County, Nevada, and Union County, New Jersey, reported that the accidents at the intersections with reversed stop signs increased after the reversal.

Based on the above information and that given in Table A-5 it is recommended that the reversed stop signs at intersections should be converted to 4-way stop signs.

CONCLUSIONS

1. The 4-way stop signs are popular with most subdivision residents, and hence are prevalent in residential areas even though they are unwarranted by the MUTCD. The probable reason for their popular use is that they are the most economical means known to satisfy public demand for the discouragement of through traffic in residential areas.
2. Unwarranted 4-way stop signs are not recommended by most government agencies.
3. It is possible to reduce the federal MUTCD warrant for streets and highways on 4-way stop signs for application to residential streets.
4. The 4-way stop signs should not be relied upon for pedestrian safety, though they have reduced vehicular accidents at many intersections.

REFERENCES

1. Alfonso Farruggia, "A Report on the Effectiveness of 2-way Stop Control vs. 4-way Stop Control." Prepared for Dr. Ira Kuperstein, Department of Civil and Environmental Engineering, New Jersey Institute of Technology.
2. R. C. Welk, "A memorandum dated January 18, 1974, on Four-Way Stop Control on Flower Valley" to Robert A. Passmore, Assistant Chief Administrative Officer, Anne Arundel County, Maryland.
3. D. E. Orme, "Responding to Tort Litigation — A Michigan Case History," Transportation Research News, No. 66, September-October 1976.
4. R. C. Walons, Telephone conversation between the author and Mr. Walons, Engineer of Traffic Operations, City Hall, Chicago, Illinois.

APPENDIX

Figure A-1
Questionnaires on 4-way and Reversed Stop Signs
QUESTIONNAIRE 1 — CONCERNING 4-WAY STOP SIGN

1. Have you used 4-way stop signs at intersections? Yes ☐ No ☐

If answer is no, go to item 8.

2. Approximate number used. Residential Area _____
Business Area _____

3. What percentage of drivers stop at these stop signs? Residential Area _____
Business Area _____

4. The confusion caused as to who has right of way is: Low ☐ Medium ☐ High ☐

5. The average number of accidents per one such intersection per year is: One ☐ Two ☐ Three ☐
Four ☐ Above Four ☐

6. The average approximate cost of total damage per accident is: \$50 ☐ \$100 ☐ \$250 ☐
\$500 ☐ Above \$1,000 ☐

7. The approximate number of legal involvements for all such accidents is: None ☐ A Few ☐ Many ☐

8. Would you like to have a summary of the results of this questionnaire? Yes ☐ No ☐

Comments: _____

QUESTIONNAIRE 2 — STOP SIGNS ACROSS MAJOR ROADS IN RESIDENTIAL AREAS

1. At intersections in residential areas, have you used stop signs across major roads instead of minor roads? Yes ☐ No ☐

If answer is no, go to item 7.

2. Approximate number used. _____

3. What percentage of drivers stop at these stop signs? _____

4. Average number of accidents per one such intersection per year. One ☐ Two ☐ Three ☐
Four ☐ Above Four ☐

5. Approximate average cost of total damage per accident. \$50 ☐ \$100 ☐ \$250 ☐
\$500 ☐ Above \$1,000 ☐

6. Approximate number of legal involvements for all such accidents. None ☐ A Few ☐ Many ☐

7. Would you like to have a summary of this questionnaire? Yes ☐ No ☐

Comments: _____

Name: _____

Title: _____

Address: _____

Phone Number : _____

Table A-1

Responses to Questionnaire No. 1 by State Departments of Transportation

State Department	1-way stop signs used	Approx. No. Used		7 Drivers Who Stopped at Sign		Confusion about Right-of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	REMARKS
		Rest.	Bus.	Rest.	Bus.					
Alabama - State Hwy. Dept.	—	—	—	—	—	—	—	—	—	—
Arizona - Dept. of Transp.	No	—	—	—	—	—	—	—	—	Not recommended for speed control. Lack of warrant leads to misuse and breeds disrespect.
Arkansas - State Hwy. Dept.	Yes	5	30	100	100	Low	—	—	—	MUTCD warranted only.
California - Dept. of Transp.	Yes	—	—	(Very good)		Low	—	—	—	MUTCD warranted only
Colorado - Dept. of Hwys.	—	—	—	—	—	—	—	—	—	MUTCD warranted only.
Connecticut - Dept. of Transp.	—	—	—	—	—	—	—	—	—	—
Delaware - Dept. of Highways & Transp.	Yes	—	—	63	—	Med.	—	—	—	Ineffective for speed control. Some effectiveness to discourage through traffic. Recommends MUTCD warranted, unless politically desired.
District of Columbia - Dept. of Transp.	Yes	100	1	No Study		Low	1	250	None	—
Florida - Dept. of Transp.	Yes	18	—	85	—	Med.	3	500	A few	MUTCD warranted only.
Georgia - Dept. of Transp.	Yes	25	5	98	98	Low	3	250	—	—
Hawaii - Dept. of Transp.	Yes	1	0	100	—	Low	1	500	—	Accident rate dropped from 12 to 1.
Idaho - Transp. Dept.	Yes	—	—	—	—	Low	—	—	A few	Recommend MUTCD warranted. Tendency to over use by local jurisdiction.
Illinois - Dept. of Transp.	—	—	—	—	—	—	—	—	—	Not recommended to discourage traffic on major or collector street.
Kansas - Dept. of Transp.	Yes	25	25	100	100	Low	—	—	None	—
Kentucky - Dept. of Transp.	Yes	—	—	—	—	Low	—	—	—	MUTCD warranted.
Louisiana - Dept. of Hwys.	Yes	10	10	70	85	Med.	3	250	A few	—
Maine - Dept. of Transp.	Yes	50	50	99	97	Low	2	250	None	—
Maryland - Dept. of Transp.	Yes	Rural only		—	—	Low	3	250	None	—
Massachusetts - Dept. of Public Works	Yes	—	—	—	—	—	—	—	—	MUTCD warranted.
Michigan - Dept. of State Hwys. & Transp.	—	—	—	—	—	—	—	—	—	MUTCD warranted. At rural highways, with lesser traffic have decreased accidents.
Minnesota - Dept. of Hwys.	Yes	45	0	90	—	Low	3	500+	A few	MUTCD warranted. Also installed due to political pressure. Used by residents to decrease speed and volume.
Mississippi - St. Hwy. Dept.	—	—	—	—	—	—	—	—	—	MUTCD warranted.
Missouri - St. Hwy. Comm.	Yes	Total 200		95	95	Low	—	—	—	—
Montana - Dept. of Hwys.	Yes	—	—	—	—	—	—	—	—	Provided a few. Have proved effective not confusing and not dangerous.
Nebraska - Dept. of Roads	Yes	300	50	—	—	—	—	—	—	Primarily used by local governments.
New Jersey - Dept. of Transp.	Yes	10	10	—	—	Med.	—	—	—	—
New Mexico - St. Hwy. Dept.	—	—	—	—	—	—	—	—	—	MUTCD warranted.
New York - Dept. of Transp.	—	—	—	—	—	—	—	—	—	MUTCD warranted.
North Carolina - Dept. of Transp.	Yes	Rural 4		Good Compliance		—	—	—	—	—
North Dakota - St. Hwy. Dept.	Yes	—	—	80	95	Low	4	500	A few	—
Ohio - Dept. of Transp.	Yes	10	—	—	—	Low	—	—	—	—

Table A-1 Continued

State Department	Signs Used	Approx. No. Used		% Drivers Who Stopped at Sign		Confusion about Right- of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	Remarks
		Resi.	Bus.	Resi.	Bus.					
Oklahoma - Dept. of Hwys.	Yes	Rural 100		95 Rural		Low	1	250	A few	—
Oregon - Dept. of Transp.	Yes	1	5	80	90	Med.	2	500	—	MUTCD warranted.
Pennsylvania - Dept. of Transp.	Yes	—	—	—	—	Low	—	—	A few	Should not be used for speed control.
Rhode Island - Dept. of Transp.	No	—	—	—	—	—	—	—	—	—
South Carolina - St. Hwy. Dept.	Yes	10	5	—	—	Med.	—	—	—	Generally they are avoided.
Tennessee - Dept. of Transp.	Yes	—	—	99	99	Low	—	—	—	MUTCD warranted.
Texas - St. Dept. of Hwys.	Yes	—	—	—	—	Low	—	—	—	—
Vermont - Dept. of Hwys.	No	—	—	—	—	—	—	—	—	—
Virginia - Dept. of Hwys. & Transp.	Yes	—	—	—	—	—	—	—	—	MUTCD warranted.
Washington - Dept. of Hwys.	A few	—	—	—	—	—	—	—	—	Served by lightly traveled secondary highways.
West Virginia - Dept. of Hwys.	Yes	—	—	—	—	Low	—	—	A few	MUTCD warranted.
Wisconsin - Dept. of Transp.	No	—	—	—	—	—	—	—	—	Municipalities do with questionable results.

Table A-2

Responses to Questionnaire No. 1 by Counties

State Departments	4-way Stop Signs Used	Approx. No. Used		7 Drivers Who Stopped at Sign		Confusion about Right-of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	REMARKS
		Rest.	Bus.	Rest.	Bus.					
California - Fresno	Yes	13	1	80	95	Med.	2	500	None	MUTCD warranted only. Once had them with bad experience. No longer used.
Marion	Yes	6	—	—	—	Low	2	—	None	Not recommended for speed control. Total complaints are probably reduced.
Monterey	Yes	—	—	—	—	—	—	—	—	MUTCD warranted only.
Sacramento	Yes	130	12 (Rural)	85	85	Low	< 1	—	None	Once had them with bad experience. No longer used.
San Bernardino	No	—	—	—	—	—	—	—	—	—
San Joaquin	Yes	11 (Rural)	11 (Urban)	99 (Rural)	99 (Urban)	Low	1	250	A few	—
Solano	Yes	3 (Rural)	1	75 (Rural)	95	Low	< 1	Low	None	—
Sonoma	Yes	3	1	95	95	Low	1	—	Few	Used on high and equal volume roads only.
Stanislaus	Yes	1	—	100	—	Low	None	—	None	Used because of citizen complaints. No reduction in speed. Complaints of noise due to brakes and acceleration. Do not recommend use of unwarranted stop sign.
Tuolumne	No	—	—	—	—	—	—	—	—	—
Tulare	Yes	5	2	50	90	High	1	250	A few	Recommend MUTCD warranted only. Installation due to political reasons.
Colorado - Denver	Yes	—	—	90	—	Low	2	250	A few	—
El Paso	Yes	1	—	80	—	Low	1	50	None	MUTCD warranted only.
Florida - Polk	Yes	4	—	Unknown		Low	2	100	None	MUTCD warranted only.
Georgia - Chatham	No	—	—	—	—	—	—	—	—	—
Dekalb	Yes	25	5	5	75	Low	1	100	No record	Recommend MUTCD warranted
Fulton	Yes	3	1	Smooth R. O. W.		Low	1	250	None	Recently installed. No real problems noticed.
Muscogee	Yes	5	1	75	95	Med.	2	500	None	Not considered good. Being discontinued to prevent enactment of ordinances.
Hawaii - Honolulu	Yes	10	0	90	—	Low	1	250	None	—
Illinois - Champaign	Yes	Rural only		—	—	Low	Minimal	—	None	MUTCD warranted only.
DuPage	Yes	5	25	98	99.6	Low	4	—	—	Accidents are a function of ADT, which averages 7,000.
Rock Island	Yes	2	3 Rural	—	—	Low	2	250	None	—
Indiana - Lake	Yes	5	3	—	—	Low	—	—	None	Seems effective.
Kansas - Sedgwick	Yes	10 Urban	2 (Rural)	All Rolling		Low	< 1	250	None	MUTCD warranted.
Louisiana - Caddo Parrish	No	—	—	—	—	—	—	—	—	MUTCD warranted. Experience with unwarranted stop signs shows disruption of normal flow, disobedience to control.
East Baton Rouge	Yes	15	10	80	80	Low	4	250	None	Recommend caution for unwarranted signs.
Maryland - Montgomery	Yes	20	10	90	90	Low	2	250	None	Their research shows that MUTCD warrants not applicable to residential areas.
Prince George	Yes	30	4	70	89 (Complete stops)	Low	2	250	A few	Mostly located for poor sight distance and on low volume roads.
Massachusetts - Middlesex	No	—	—	—	—	—	—	—	—	—
Worcester	Yes	Very Few		—	—	Low	3	250	A few	—

Table A-2 Continued

State Department	4-Way Stop Signs Used	Approx. No. Used		% Drivers Who Stopped at Sign		Confusion about Right-of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	Remarks
		Resid.	Bus.	Resid.	Bus.					
Michigan - Genesee	Yes	35	—	60	—	Low	1	250	None	Mitigate complaints regarding speeding. Provide psychological benefit of apparent safety.
Kent	Yes	—	1	—	70	Low	4	500	None	MUTCD warranted.
Oakland	No	—	—	—	—	—	—	—	—	Used yield sign alternating on major and minor street to reduce speed and discourage through traffic. Have reduced accidents.
Saginaw	Yes	18	4	99	100	Low	3	250	A few	MUTCD warranted.
Washtenaw	Yes	Unknown	—	90+	—	Low	2	250	None	—
Minnesota - Hennepin	Yes	8	6	100	100	Low	4	250	A few	MUTCD warranted.
Ramsey	Yes	17	24	—	—	Low	3	250	A few	—
St. Louis	Yes	—	—	99	—	Low	Very Low	100	None	—
Missouri - St. Louis	—	—	—	—	—	—	—	—	—	Against unwarranted use of stop signs.
Nebraska - Douglas	Yes	20	4	100	100	Med.	1	500	None	Accidents increased with increased traffic and deviation from MUTCD. Against improper placement of signs. Two locations on municipal roads. MUTCD warranted.
Nevada - Clark	Yes	31	23	80	99	Low	—	500	—	
New Jersey - Essex	—	—	—	—	—	—	—	—	—	
Middlesex	No	—	—	—	—	—	—	—	—	New Jersey DOT has jurisdiction on all streets and will not allow 4-way stopping.
Monmouth	Yes	1	—	—	—	—	—	—	—	
Passaic	No	—	—	—	—	—	—	—	—	
Union	Yes	1	—	48	—	—	—	—	—	Decrease driver's degree of surveillance.
New York - Broome	No	—	—	—	—	—	—	—	—	Poor observance of stop signs. Drivers exhibit stop and start response at the first 2-way stop thereafter.
Erie	Yes	—	—	—	—	—	—	—	—	
Monroe	Yes	25	0	—	—	Low	1	—	None	
Nassau	No	—	—	—	—	—	—	—	—	Minimize accidents.
Oneida	Yes	2	—	100	—	Low	0	—	None	
Onondaga	Yes	—	—	—	—	—	—	—	—	
Rock Island	—	—	—	—	—	—	—	—	—	Recommend against use for discouraging speed and through traffic.
Suffolk	Yes	6	—	99	—	High	4	100	—	MUTCD warranted. They reduced accident severity even though the accident rate increased.
Westchester	No	—	—	—	—	—	—	—	—	Misuse breeds disrespect.
Ohio - Cuyahoga	No	—	—	—	—	—	—	—	—	MUTCD warranted.
Franklin	Yes	10	1	90	100	Med.	4	—	—	—
Hamilton	Yes	10	5	90	95	Low	2	500	A few	MUTCD warranted.
Lucas	Yes	50	—	65	—	High	1	250	None	It is not a good traffic engineering measure.
Montgomery	—	—	—	—	—	—	—	—	—	Breeds disrespect for stop signs. Makes drivers less cautious at 2-way stop signs.
Summit	Yes	5	—	—	99	Med.	1	100	None	MUTCD warranted. Discourage multiple stop signs.
Oregon - Multnomah	Yes	20	—	90	—	—	1.45	—	—	Installed by enforcing municipalities. Trying to negotiate with communities for removal of stop signs which do not meet state warrants.
Pennsylvania - Alleghany	Yes	10	0	—	—	—	—	—	—	
Lancaster	—	—	—	—	—	—	—	—	—	

Table A-2 Continued

State Department	4-Way Stop Signs Used	Approx. No. Used		% Drivers Who Stopped at Sign		Confusion about Right- of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	Remarks
		Resl.	Bus.	Resl.	Bus.					
Rhode Island - Providence	Yes	6	0	50	—	Med.	—	—	—	—
Virginia - Arlington	Yes	2	1	100	100	Low	1	—	None	Politically mandated in residential areas. In business areas they satisfy MUTCD warrants.
Washington - Snohomish	Yes	6	—	100	—	Low	1.79	—	None	—
Wisconsin - Dane	Yes	5 (Rural)	3	Good	—	Low	—	—	—	Accidents reduced at the intersection of two major highways.
Waukesha	Yes	10	5	98	98	Low	—	—	None	MUTCD warranted.

Table A-3
Responses to Questionnaire No. 1 by Cities

State Departments	4-Way Stop Signs Used	Approx. No. Used		% Drivers Who Stopped at Sign		Confusion about Right-of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	REMARKS
		Resi.	Bus.	Res.	Bus.					
Alabama - Birmingham	Yes	35	10	75	90	Low	4	500	A few	Not for speed control.
Arizona - Phoenix	Yes	29	—	Good		Med.	1	Low	A few	MUTCD warranted only. Recommend no stoppage of free flow on collector street.
California - Alameda	Yes	4	0	94	—	Low	3	250	A few	—
Berkeley	Yes	60	3	21	25	Low	2	250	—	—
Burbank	Yes	61	6	99	99	Low	< 1	250	None	—
Cupertino	Yes	5	0	< 36	—	Low	1	—	None	They mitigate complaints about speed. Provide residents with psychological benefit of apparent safety.
Hayward	Yes	40	2	90	80	Med.	2	250	A few	—
Long Beach	—	—	—	—	—	Low	—	—	None	—
Los Angeles	Yes	425 Total		—	—	Low	—	—	None	Experience indicates use by MUTCD warrants only.
Norwalk	Yes	—	—	99	99	Low	1	—	—	MUTCD warranted.
Sacramento	Yes	Too many		60	—	Low	—	—	—	—
San Jose	Yes	74	7	—	—	Low	Res. 1 Bus. 4	—	None	Answers based on 1975 accident data.
Santa	Yes	10	8	—	—	Low	1	500	None	—
Torrance	Yes	96	10	15	98	Low	< 1	500	A few	Low compliance is due to unwarranted 4-way stops.
Georgia - Atlanta	Yes	120	12	75	75	Low	2	500	A few	Difficult subject to reconcile with MUTCD.
Illinois - Chicago	Yes	700	50	75	97 (Complete stops)	Low	2	250	A few	On residential streets MUTCD warrants are not strictly followed. The 4-way sign also provided when traffic volume ratio is below 2:1 on the cross-roads. System in use for many years with resident satisfaction.
Kansas - Kansas City	Yes	5	3	95	90	Low	3	500	A few	—
Louisiana - Baton Rouge	Yes	10	1	80	80	Low	2	100	None	No driver confusion, except when first installed.
New Orleans	Yes	30	1	99	99	Med.	1	500	A few	MUTCD warranted.
Maryland - Baltimore	Yes	30	0	—	—	—	—	—	—	Follow MUTCD.
Massachusetts - Boston	No	—	—	—	—	—	—	—	—	Unusual stop signs discouraged.
Michigan - Detroit	Yes	—	—	16	16	Low	< 2	—	—	—
Minnesota - Minneapolis	Yes	100	20	98	98	Low	3	500	A few	—
Missouri - St. Louis	Yes	250	75	80	90	Low	Res. 2 Bus. 4	250	A few	Many unwarranted MUTCD 4-way stop signs installed by legislative act.
New Jersey - Newark	No	—	—	—	—	—	—	—	—	—
New York - Buffalo	Yes	100	0	Less than on 2-way		—	—	—	—	Frequent use causes confusion at 2-way stop signs thereafter.
Ohio - Cincinnati	Yes	10	5	90	95	Low	2	500	A few	MUTCD warranted. Not permitted by Ohio law.
Columbus	Yes	20	0	75	—	High	3	250	—	MUTCD warranted. Not permitted by Ohio law.

Table A-3 Continued

State Departments	4-Way Stop Signs Used	Approx. No. Used		% Drivers Who Stopped at Sign		Confusion about Right-of-way.	No. of accidents per intersec.	Cost per accident	No. of legal invl. per accident	Remarks
		Resl.	Bus.	Resl.	Bus.					
Oregon - Portland	Yes	80	10	95	99	Low	1	500	A Few	—
Pennsylvania - Philadelphia	Yes	Nearly all (Total 1850)	Few	90	90	Low	3	500	Yes	Nearly all residential areas have 4-way stop signs. Very much satisfied with them.
Pittsburgh	Yes			100	100	Low	1	500	None	
Texas - Austin	Yes	75	4	95	95	Med.	4	100	A Few	—
Fort Worth	Yes	84	—	—	—	Low	—	—	Many	50' to 70' complete stops.
Washington - Seattle	Yes	2	—	60	—	Low	0	—	None	

Table A-4

Summary Tabulation of Responses to Questionnaire No. 1

Question	Number of Respondents			
	States & D. C.	Counties	Cities	All
1. No. of agencies questioned.	50	134	58	242
2. No. of agencies responding.	43	68	30	141
3. Have you used 4-way stop signs?				
Yes	32	53	27	112
No	4	11	1	16
No Answer	7	4	2	13
4. Average number used by the responding agencies.				
Residential	53	15	171	80
Business	22	6	17	15
5. Percentage drivers who stopped at the stop sign.				
Residential	90	83	75	83
Business	96	93	85	<u>91</u>
			Avg.	87
6. Confusion caused as to the right-of-way.				
Low	19	36	24	79
Medium	6	6	2	14
High	0	3	1	4
7. No. of accidents per intersection.	2.2	1.8	2.1	2
8. Cost per accident.	\$363	\$252	\$307	\$307
9. No. of legal involvements per accident.				
None	4	28	7	39
A few	8	9	13	30
Many	0	0	1	1
10. MUTCD Warranted? (From comments only.)	19+	24+	7+	50+

Table A-5
Summary of Answers to Questionnaire No. 2

State — Agency	No. Used	% Drivers Stopped	No. of Accidents per Intersec.	Cost per Accident	No. of Legal Involvements per Accident	Remarks
Delaware — Dept. of Hwys.	Unknown	Unknown	Unknown	Unknown	Unknown	—
Georgia — Muscogee County	10	75	3	\$500	None	—
Nevada — Clark County	100	< 50	3	\$250	—	Accidents increased
Maryland — Prince George County	10	80	4	\$250	A few	Provided if adequate alternate route available.
Michigan — Genesee County	2-3	90	1	\$250	None	—
Michigan — Oakland County	10	50+	< 1	—	None	—
New Jersey — Union County	4	—	—	—	—	Now removed because accidents increased.
Ohio — Franklin County	4	90+	3	—	—	ADT 3000 or less.
Ohio — Lucas County	25	75	2	—	None	Discourages use.
California — Alameda	1	94	3	\$250	A few	—
California — Norwalk	—	80	0	—	—	—
California — Sacramento	12	50	2	—	—	—
Illinois — Chicago	200	75	3	\$250	A few	All converted to 4-way stop signs.
Pennsylvania — Philadelphia	Several dozens	—	—	—	—	—
Washington — Seattle	2	60	None	None	None	Installed for 2 1/2 months only.